

(12) **United States Patent**
Sanders et al.

(10) **Patent No.:** **US 9,345,483 B1**
(45) **Date of Patent:** **May 24, 2016**

- (54) **STRAP TIE SYSTEM**
- (71) Applicant: **FOOT INNOVATIONS, LLC**, Tampa, FL (US)
- (72) Inventors: **Roy W. Sanders**, Tampa, FL (US);
Sergio Gutierrez, Tampa, FL (US)
- (73) Assignee: **Foot Innovations, LLC**, Tampa, FL (US)
- (*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

7,591,835 B2	9/2009	Warren
7,686,829 B2	3/2010	Elliott et al.
7,972,347 B2	7/2011	Garvin et al.
7,972,362 B2	7/2011	Wilke et al.
7,981,136 B2	7/2011	Weiser
D652,145 S	1/2012	Topaz
8,764,792 B2	7/2014	Weiser
8,864,796 B2	10/2014	Elliott et al.
8,916,741 B2	12/2014	Fischell et al.
2004/0204740 A1	10/2004	Weiser
2004/0267309 A1	12/2004	Garvin
2007/0038247 A1	2/2007	Lebner et al.
2009/0036922 A1*	2/2009	Riskin et al. 606/215
2014/0236227 A1	8/2014	Nash et al.
2015/0088195 A1	3/2015	Moustafa

FOREIGN PATENT DOCUMENTS

(21) Appl. No.: **14/734,846**

GB 2 223 410 4/1990

(22) Filed: **Jun. 9, 2015**

* cited by examiner

(51) **Int. Cl.**
A61B 17/08 (2006.01)

Primary Examiner — Ryan J Severson

(52) **U.S. Cl.**
CPC **A61B 17/083** (2013.01); **A61B 2017/081** (2013.01); **A61B 17/086** (2013.01); **A61B 2017/088** (2013.01)

Assistant Examiner — Christian Knauss

(74) *Attorney, Agent, or Firm* — Foley & Lardner LLP; Christopher J. McKenna

(58) **Field of Classification Search**
CPC A61B 17/08; A61B 17/083; A61B 17/085; A61B 2017/081; A61B 2017/086; A61B 2017/088; A61B 17/0466; Y10T 24/1498
USPC 606/215, 216, 217, 218
See application file for complete search history.

(57) **ABSTRACT**

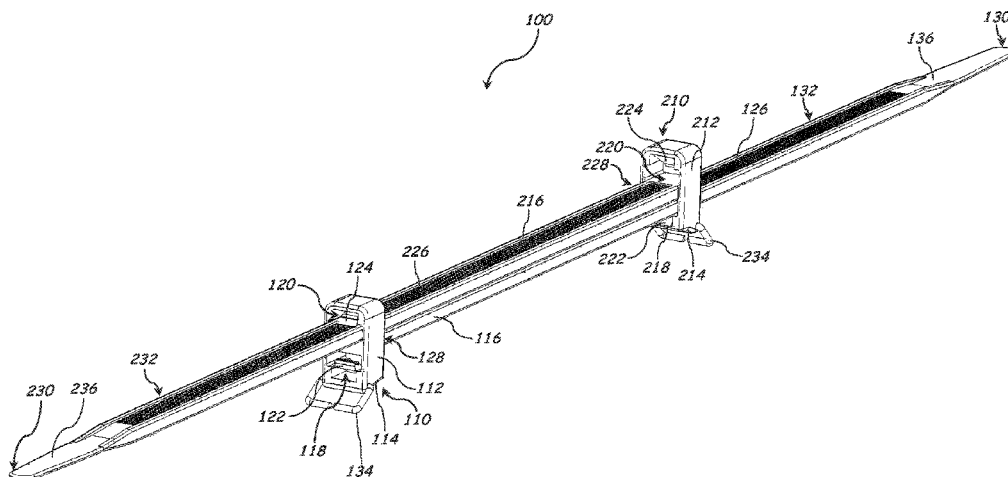
A strap tie assembly includes a first strap tie and a second strap tie. The first strap tie includes a first base, a first body including a first opening and a first engagement member disposed within the first opening, and a first strap extending from the first body. The first strap includes a plurality of movement restriction members disposed along a surface of the first strap. The second strap tie includes a second base, a second body including a second opening and a second engagement member disposed within the second opening, and a second strap extending from the second body. The first strap tie is configured to receive the second strap and prevent translation of the second strap away from the first body. The second strap tie is configured to receive the first strap and prevent translation of the first strap away from the second body.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,926,193 A *	12/1975	Hasson 606/218
3,971,384 A	7/1976	Hasson	
4,924,866 A	5/1990	Yoon	
D333,193 S	2/1993	Archambault	
5,263,970 A	11/1993	Preller	
5,562,705 A	10/1996	Whiteford	
6,176,868 B1	1/2001	Detour	
7,361,185 B2	4/2008	O'Malley et al.	

20 Claims, 31 Drawing Sheets



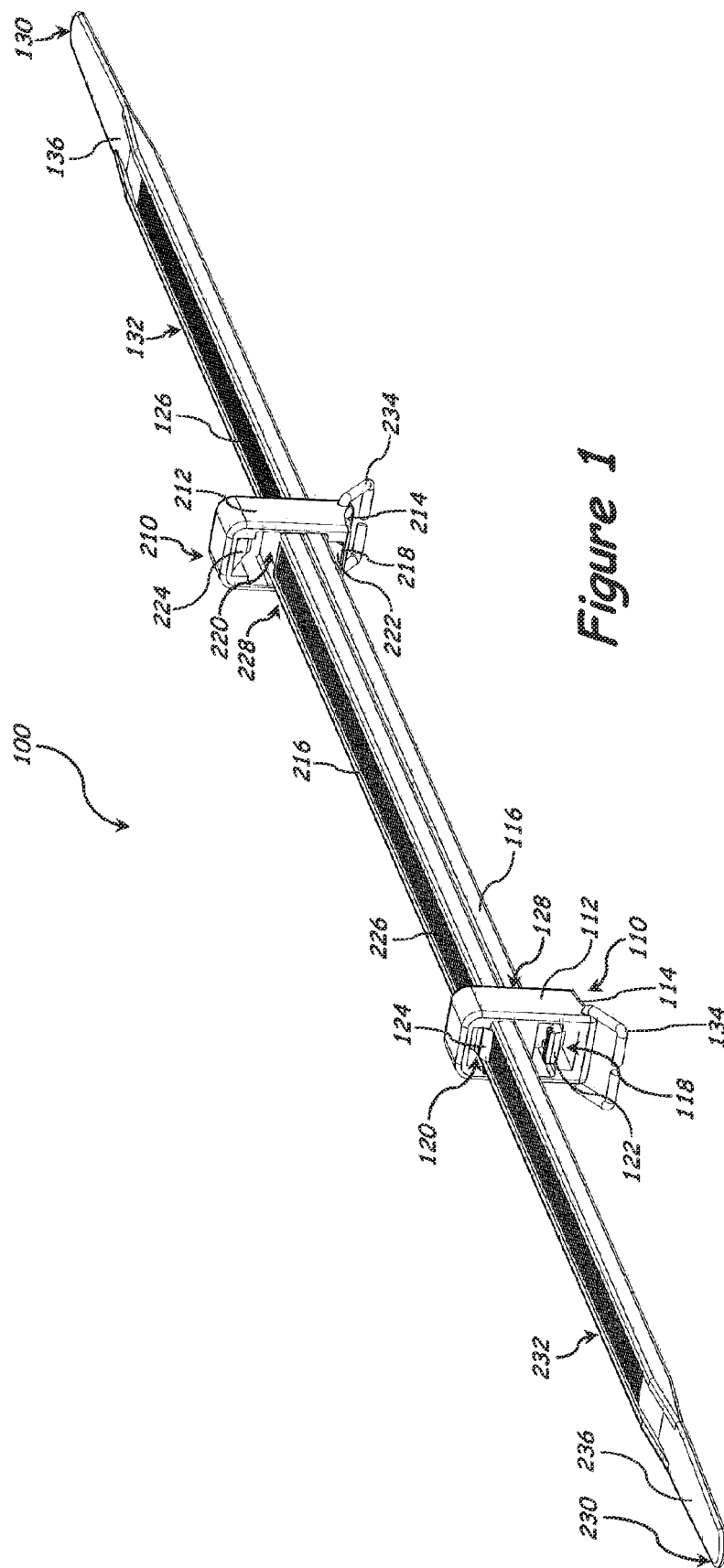


Figure 1

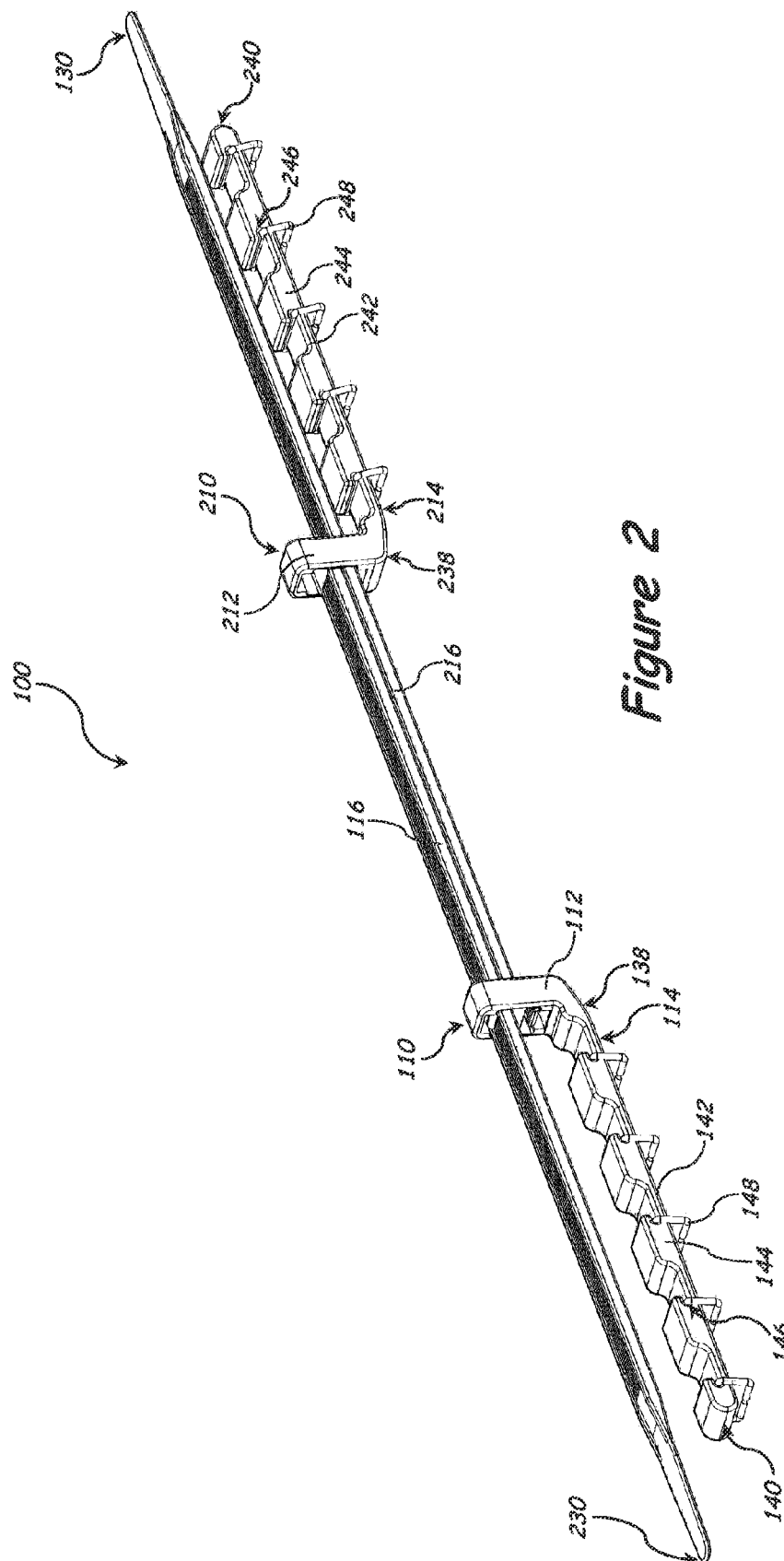
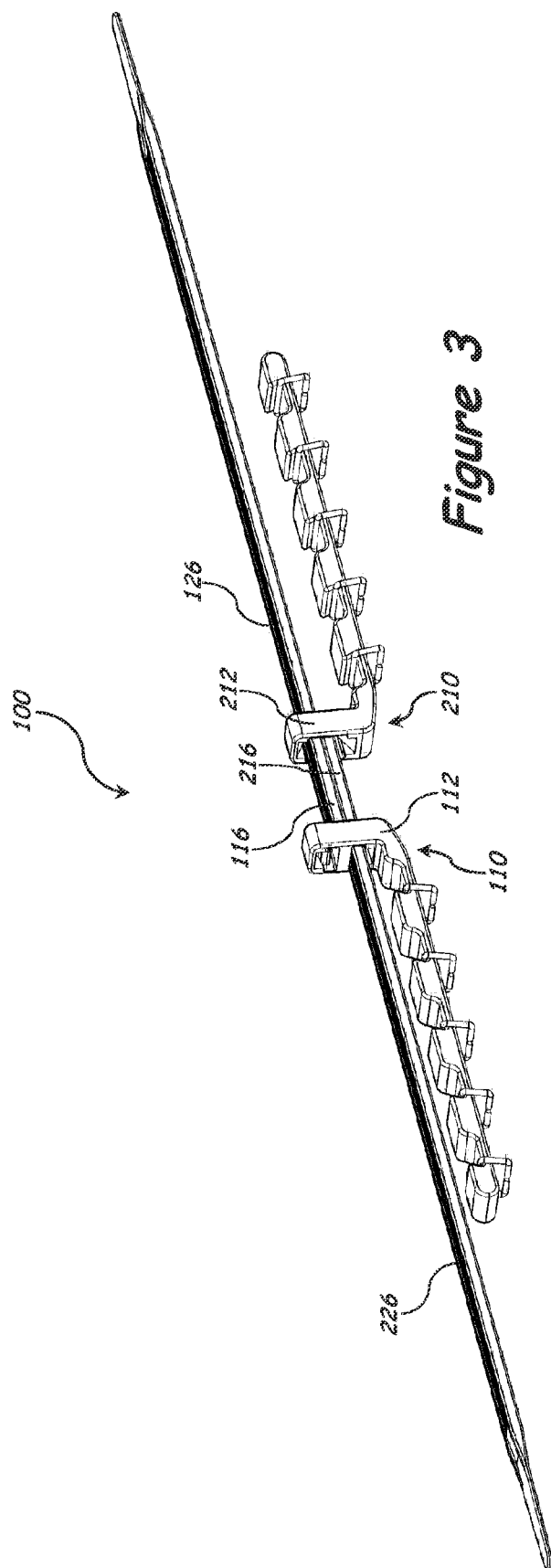
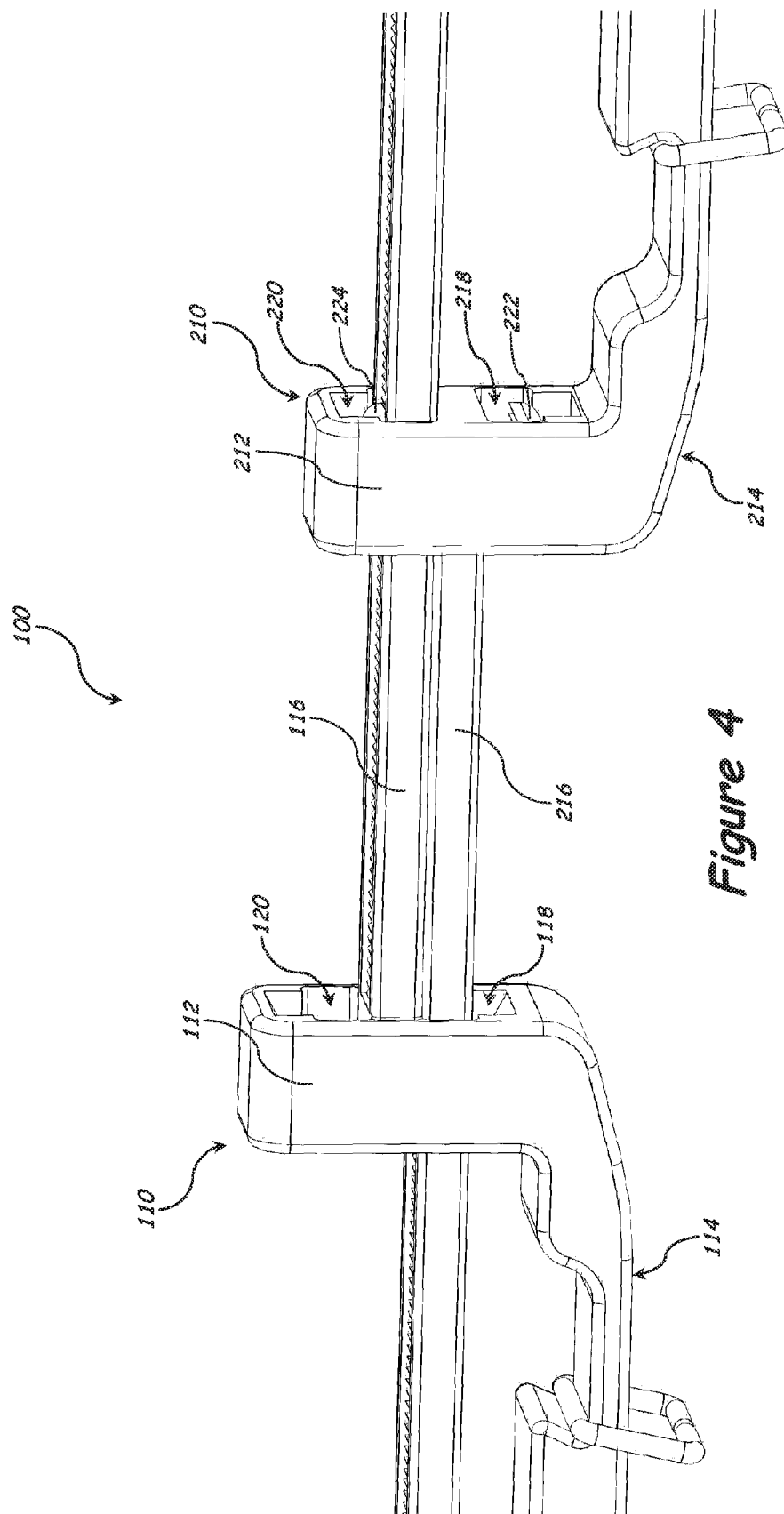
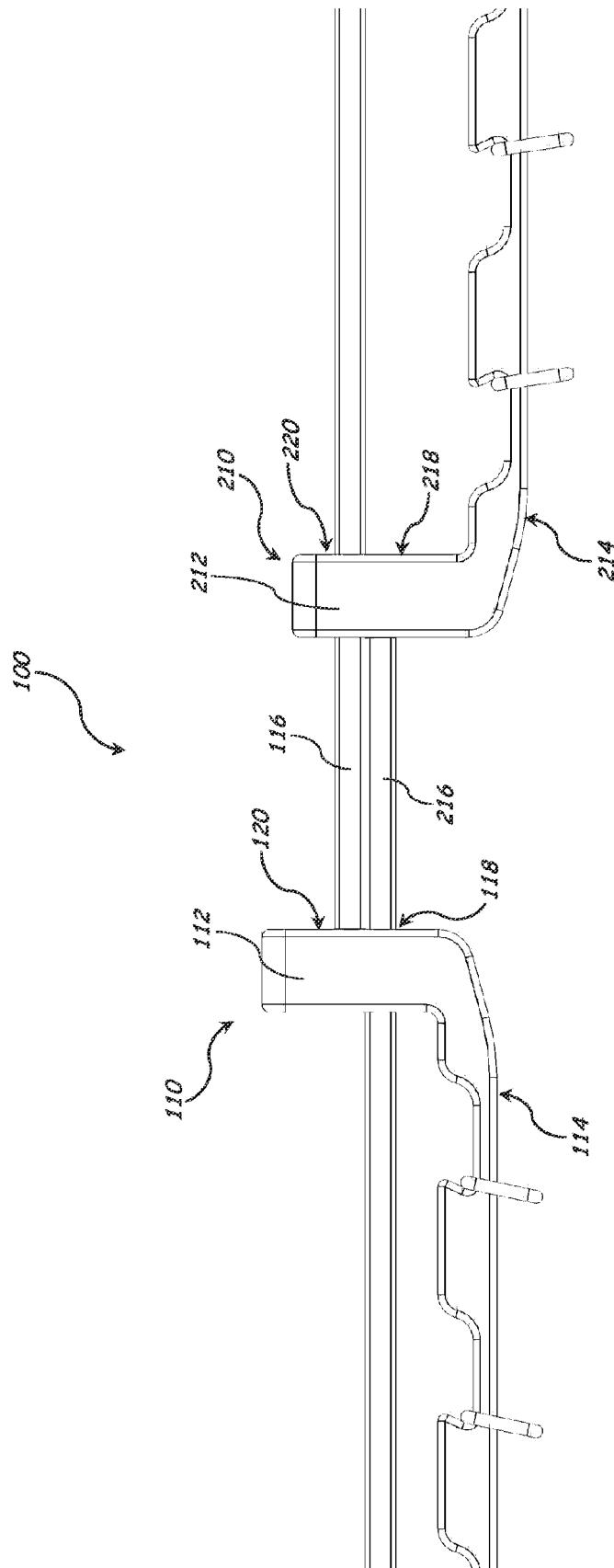
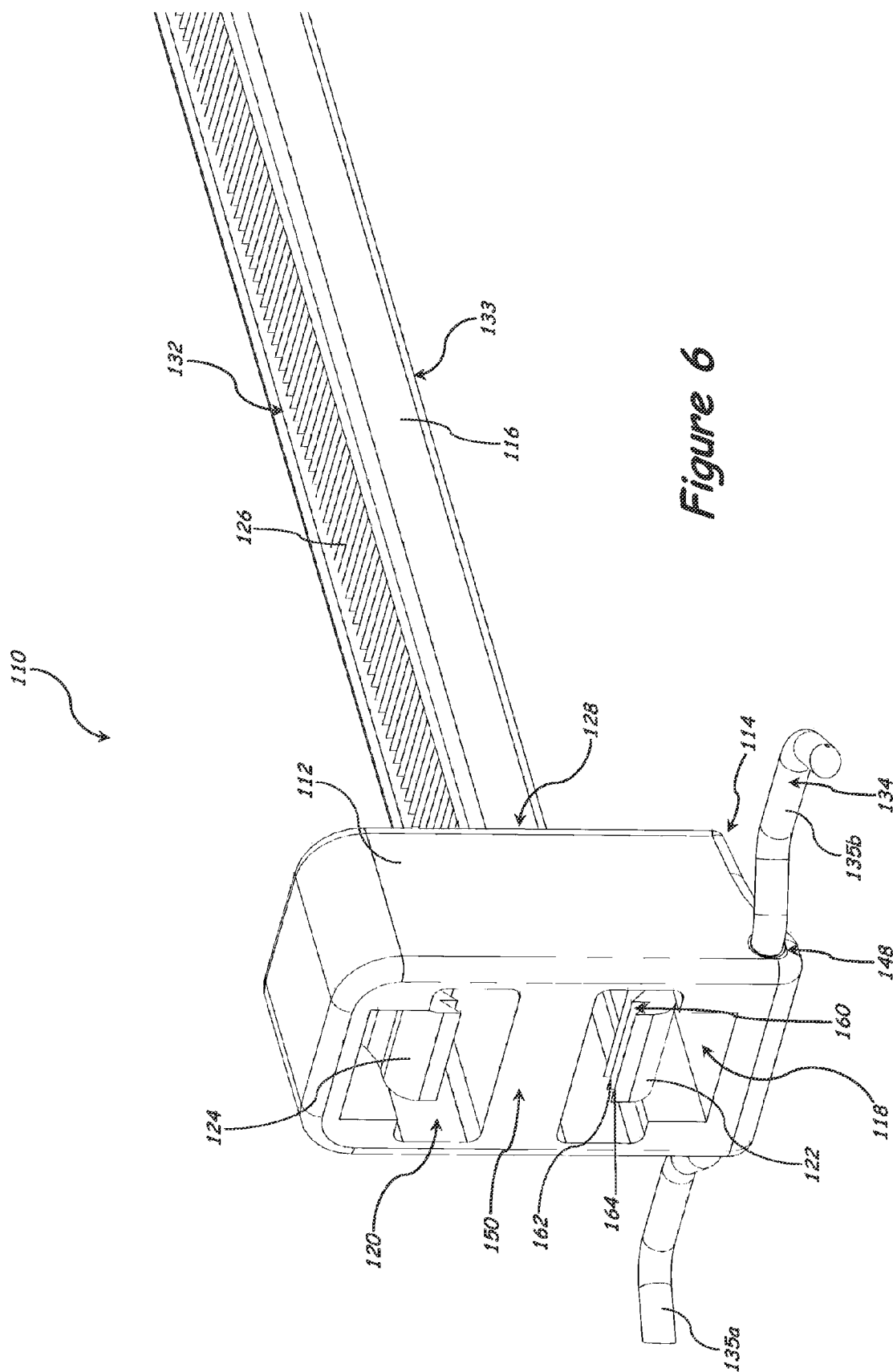


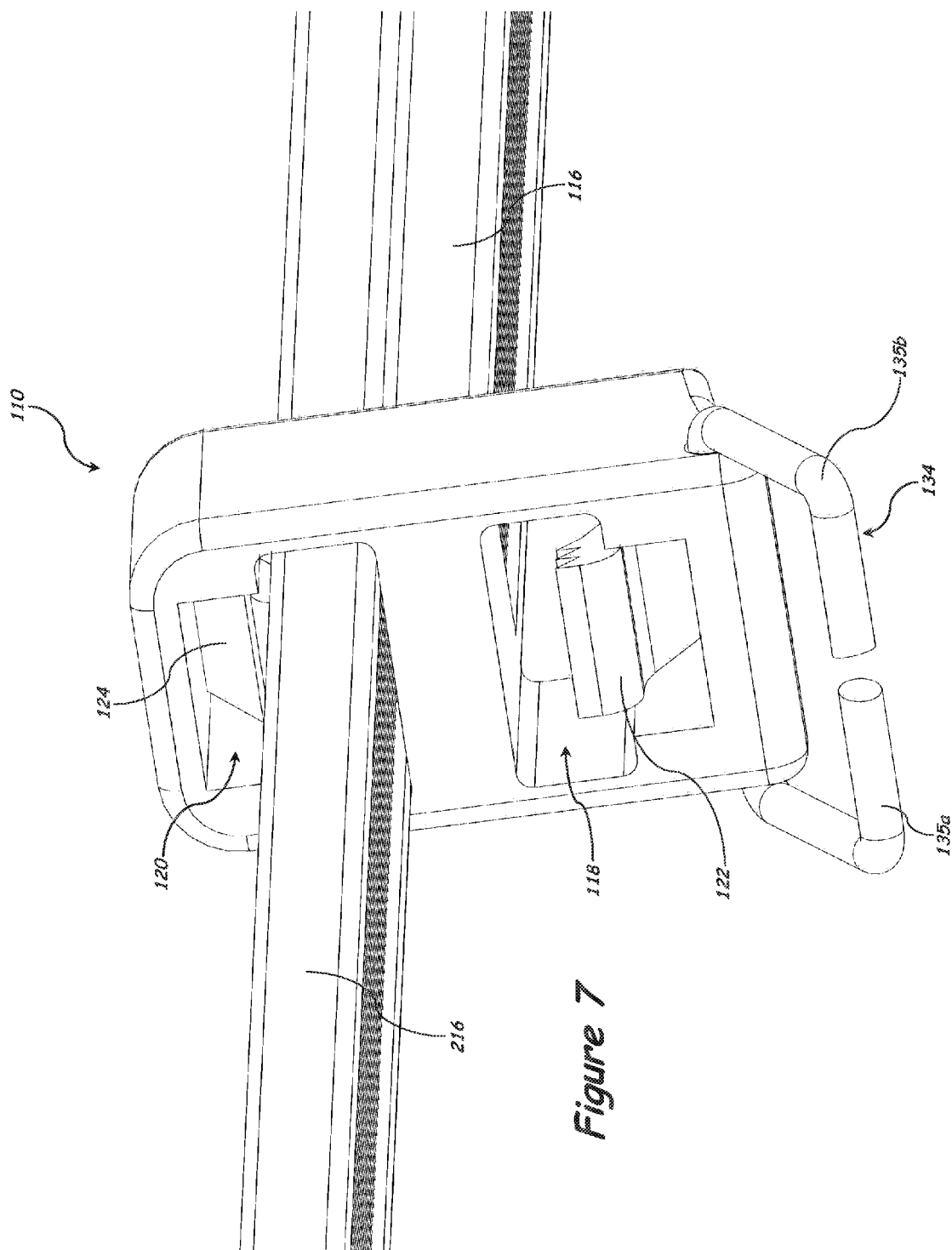
Figure 2











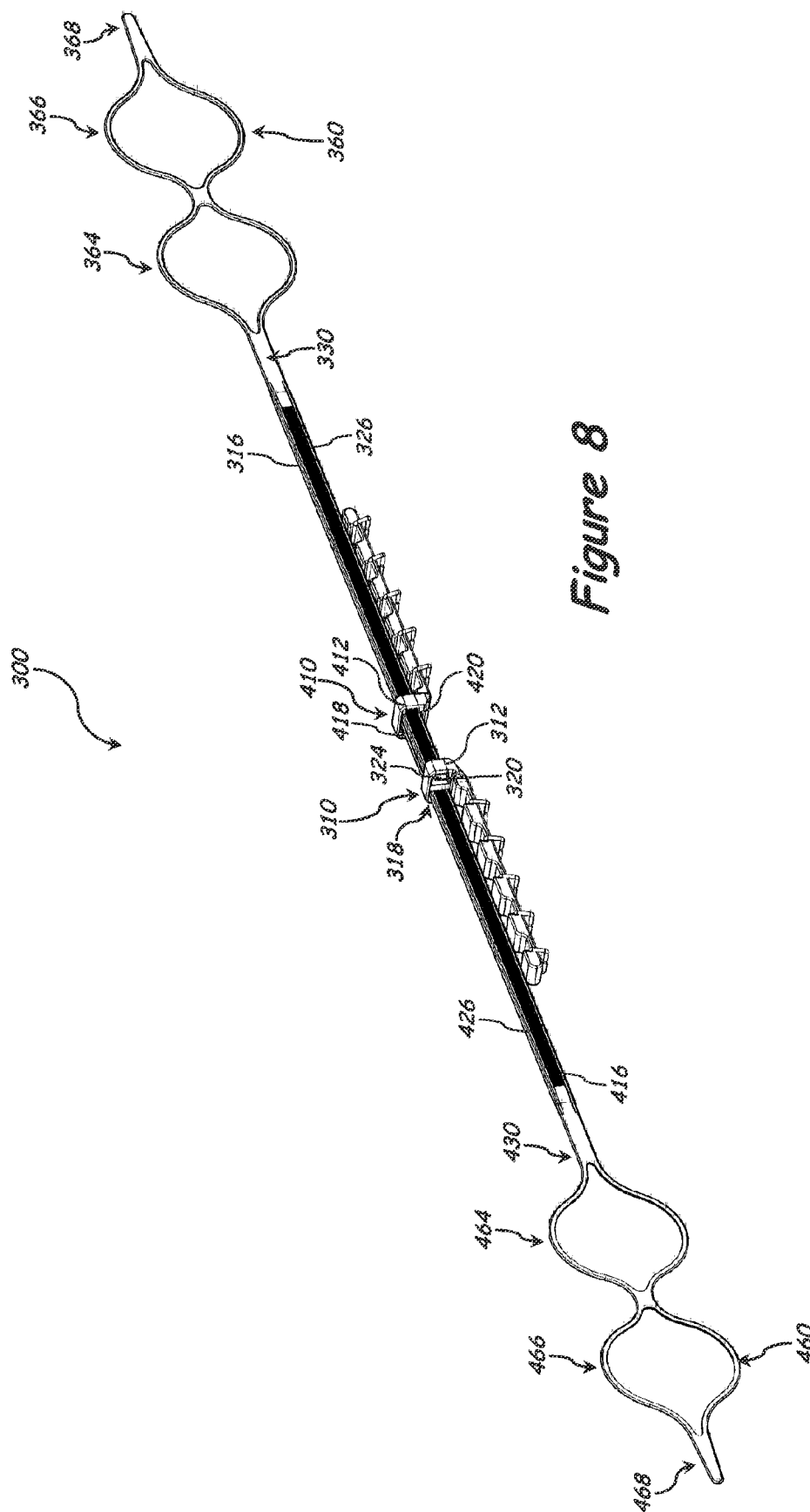


Figure 8

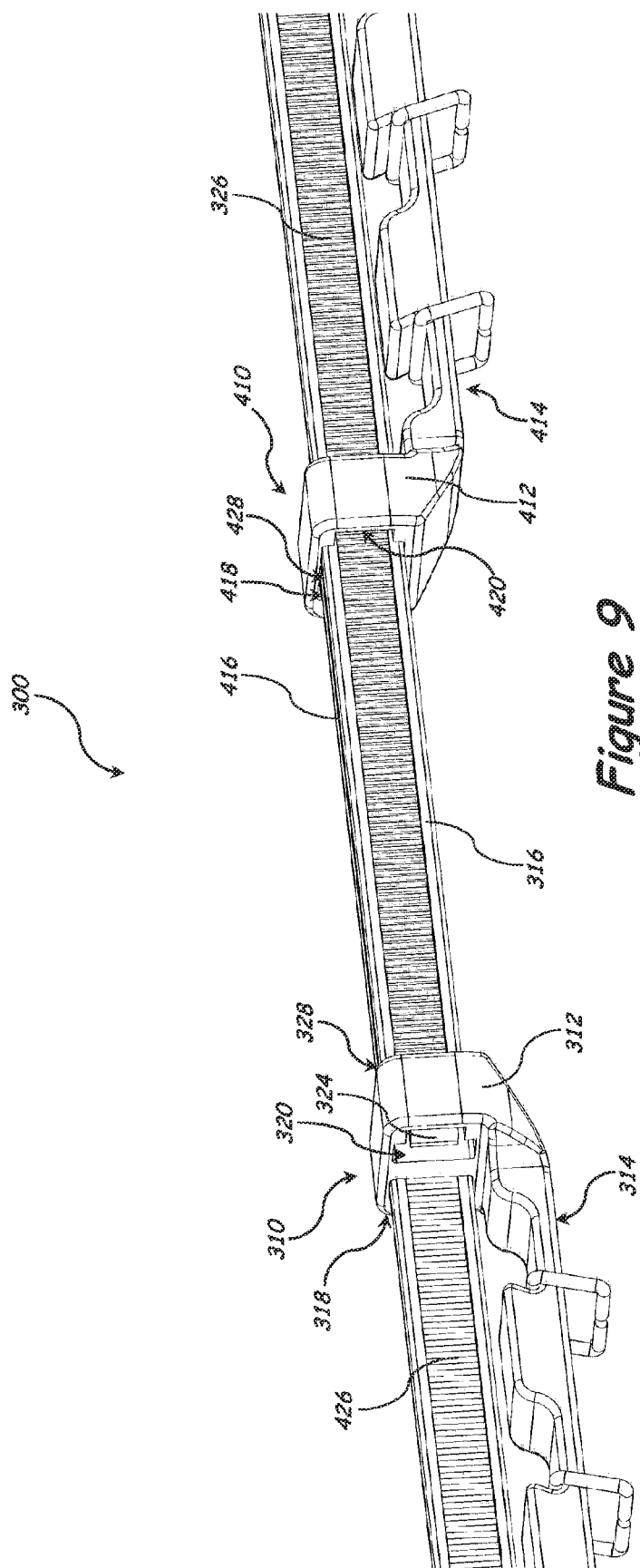
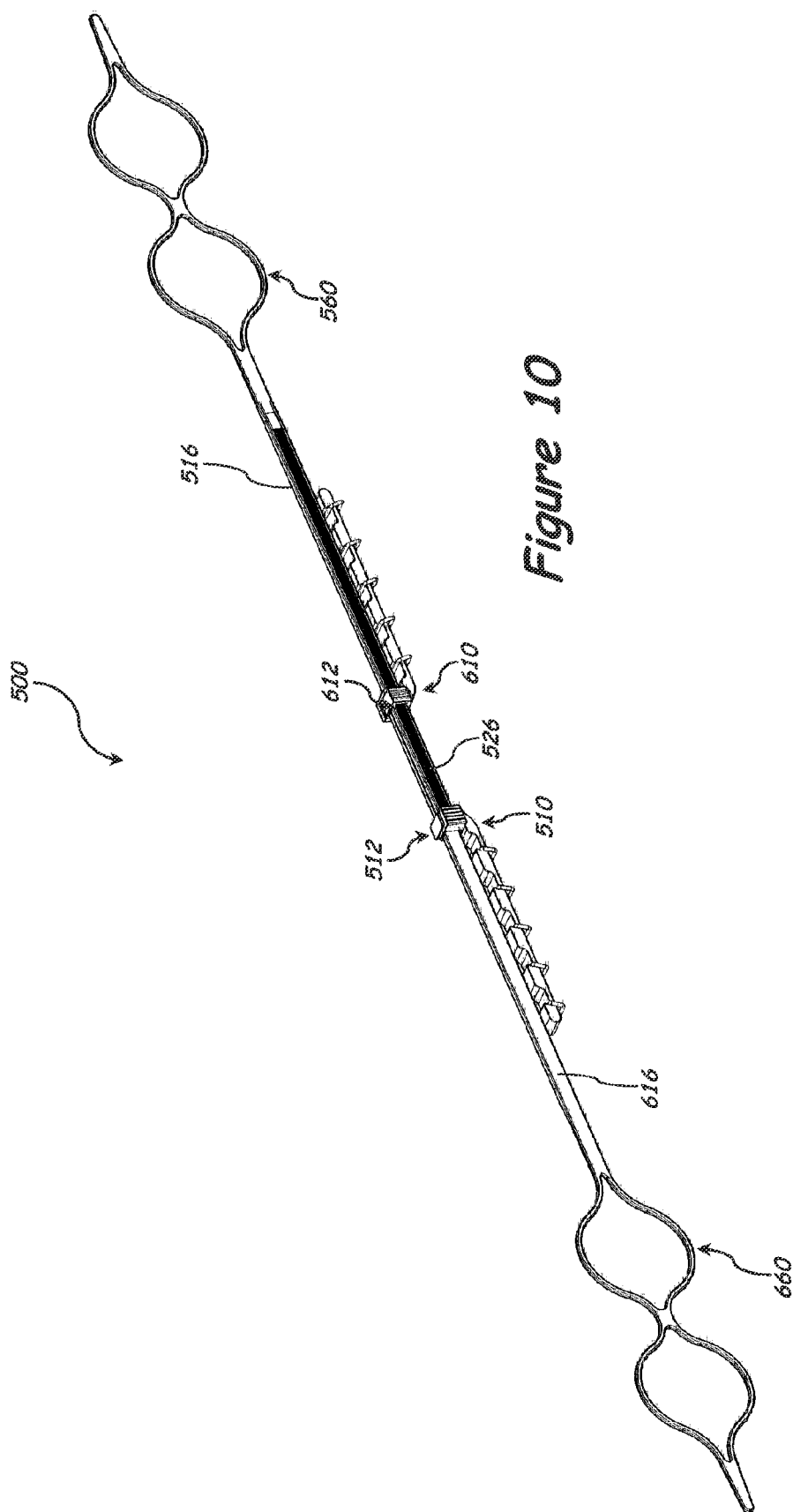


Figure 9



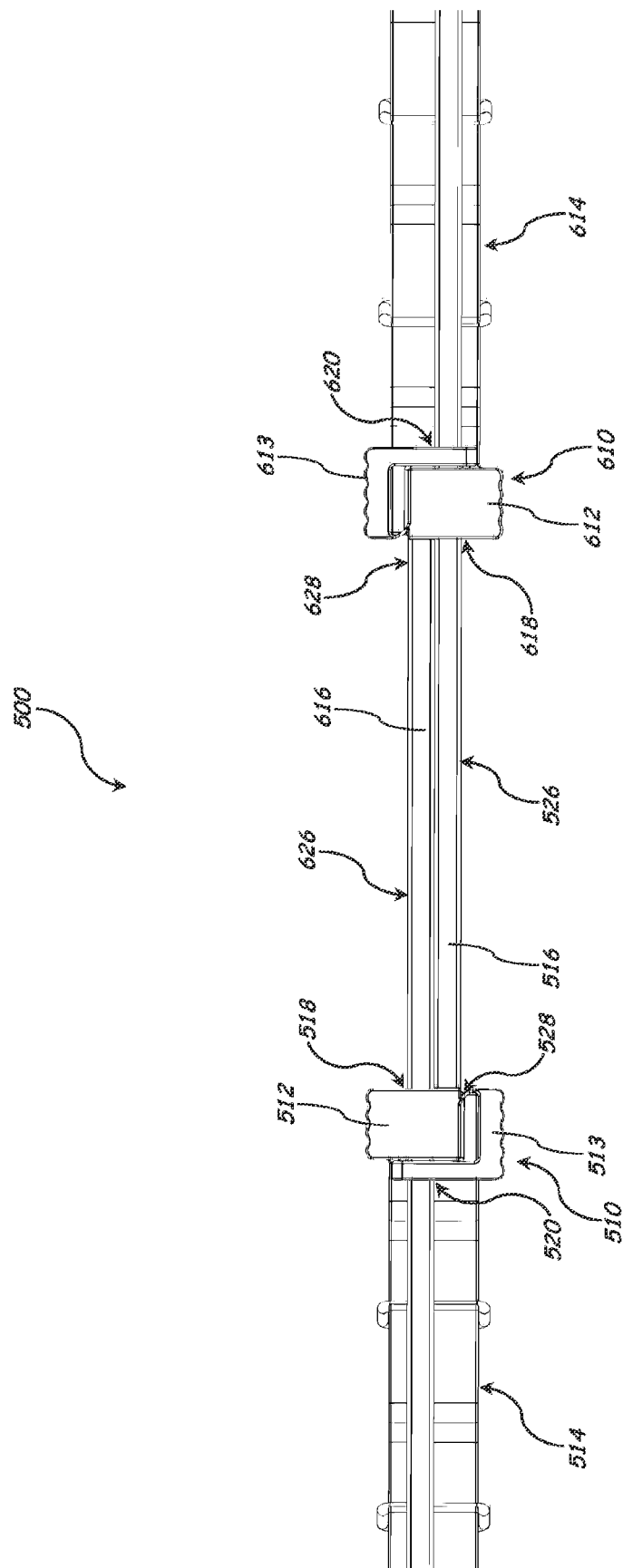


Figure 11

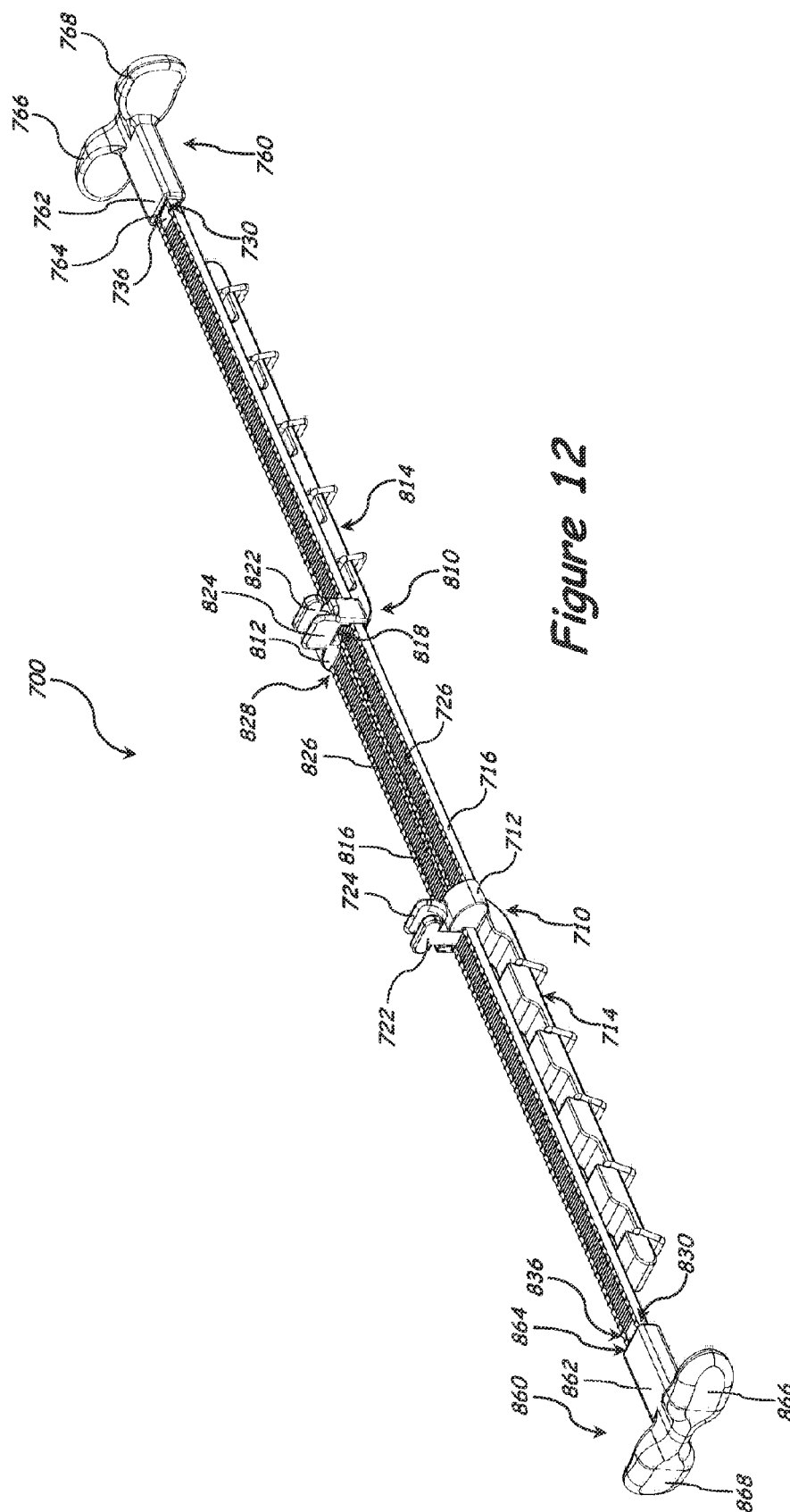
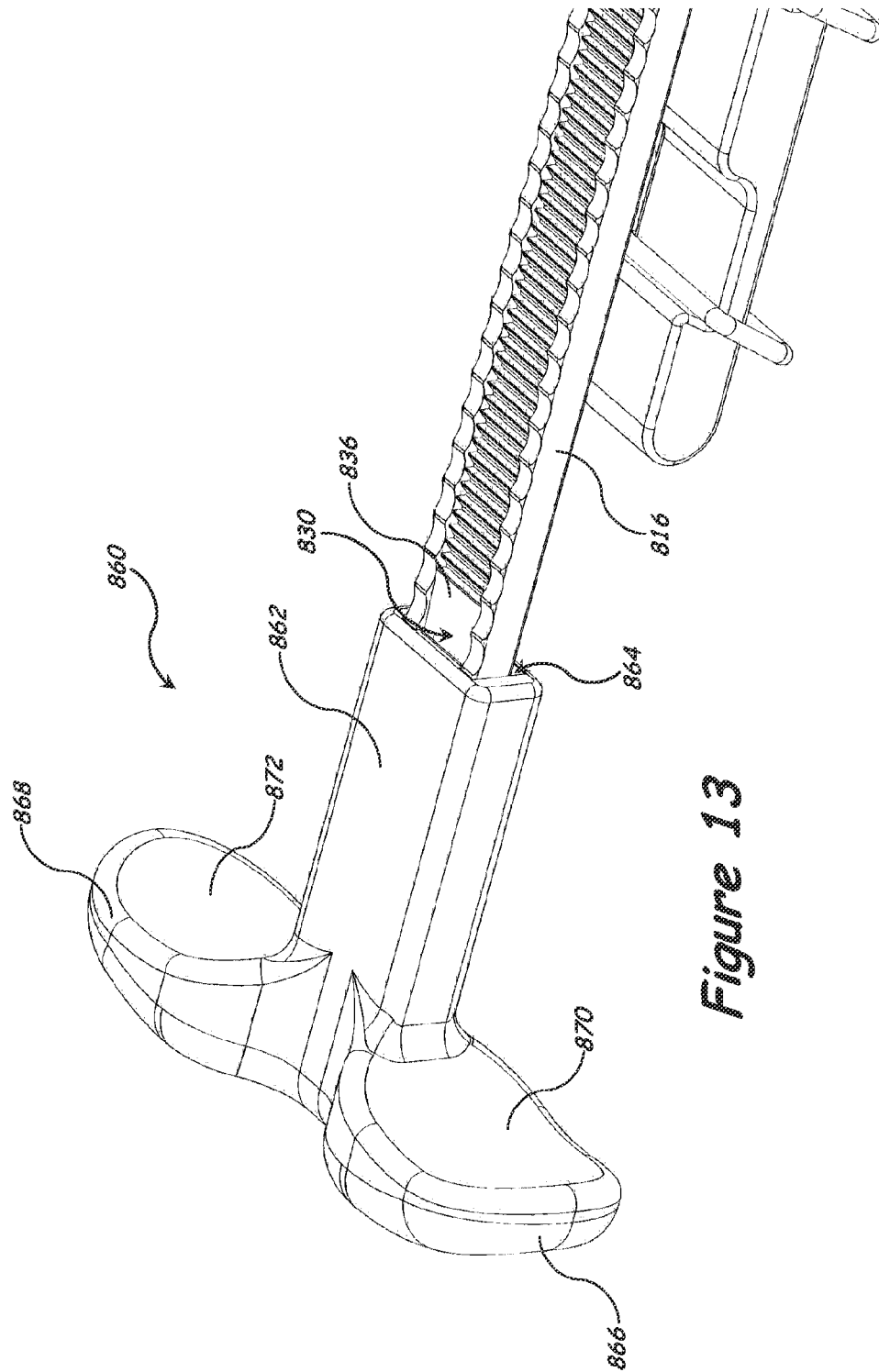
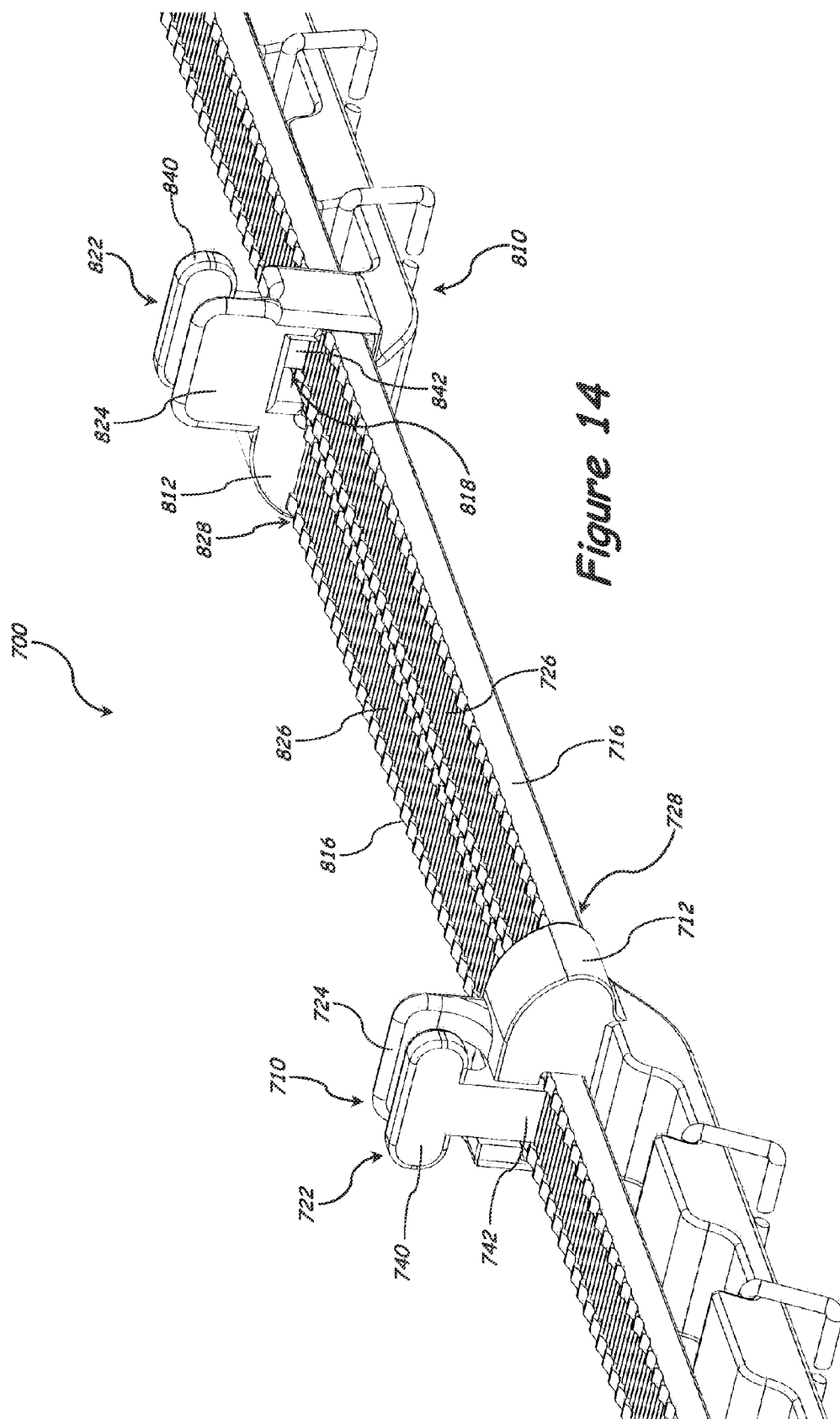
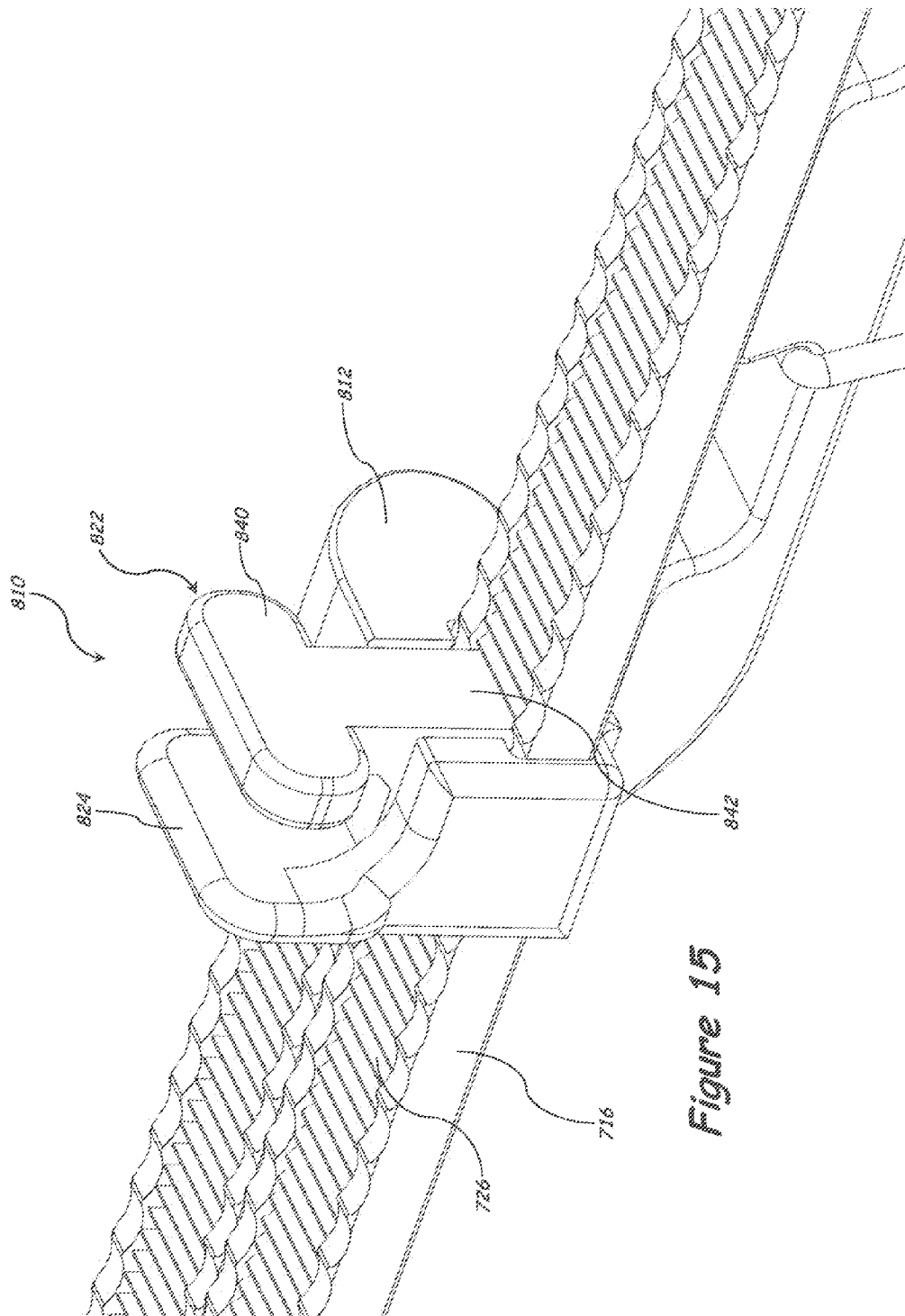
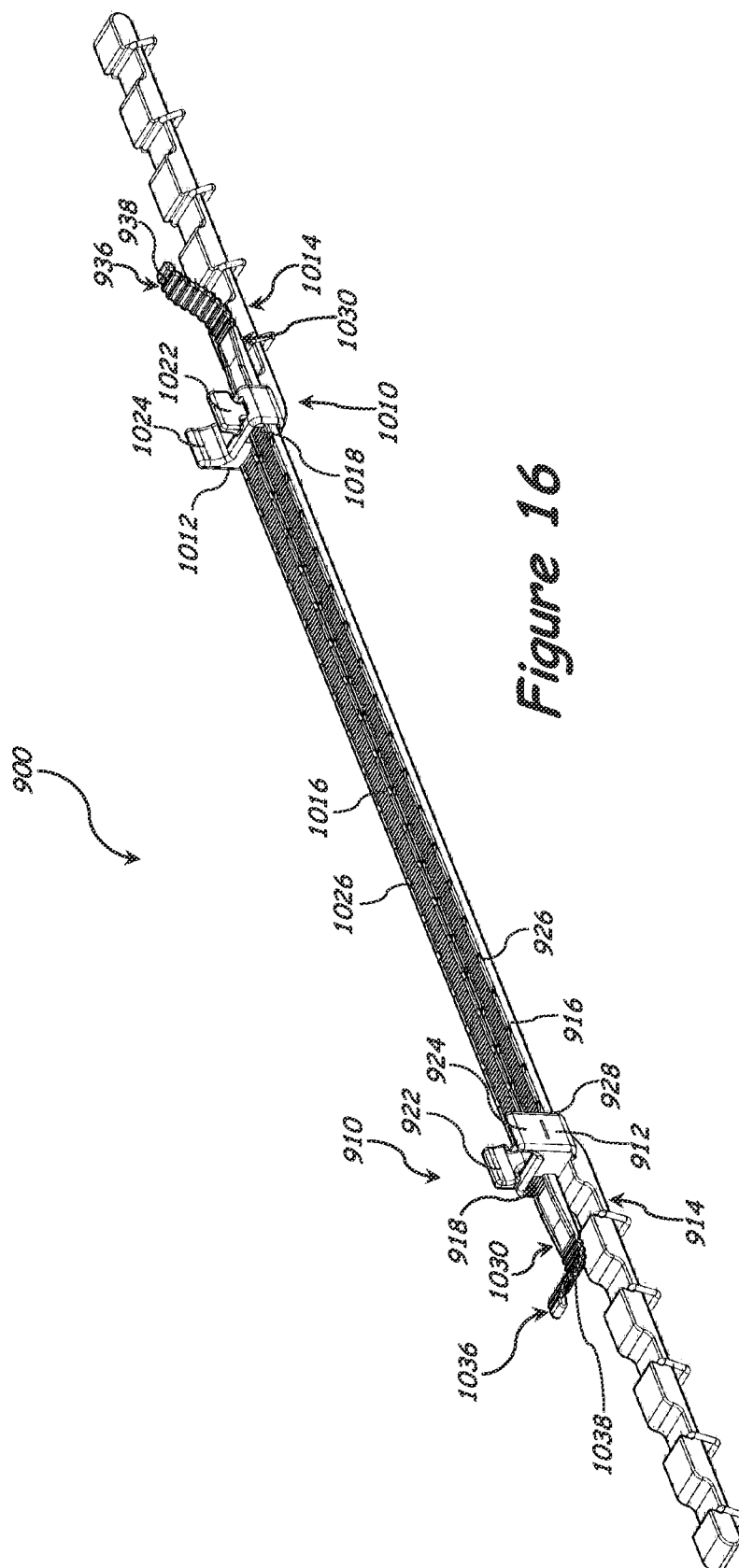


Figure 12









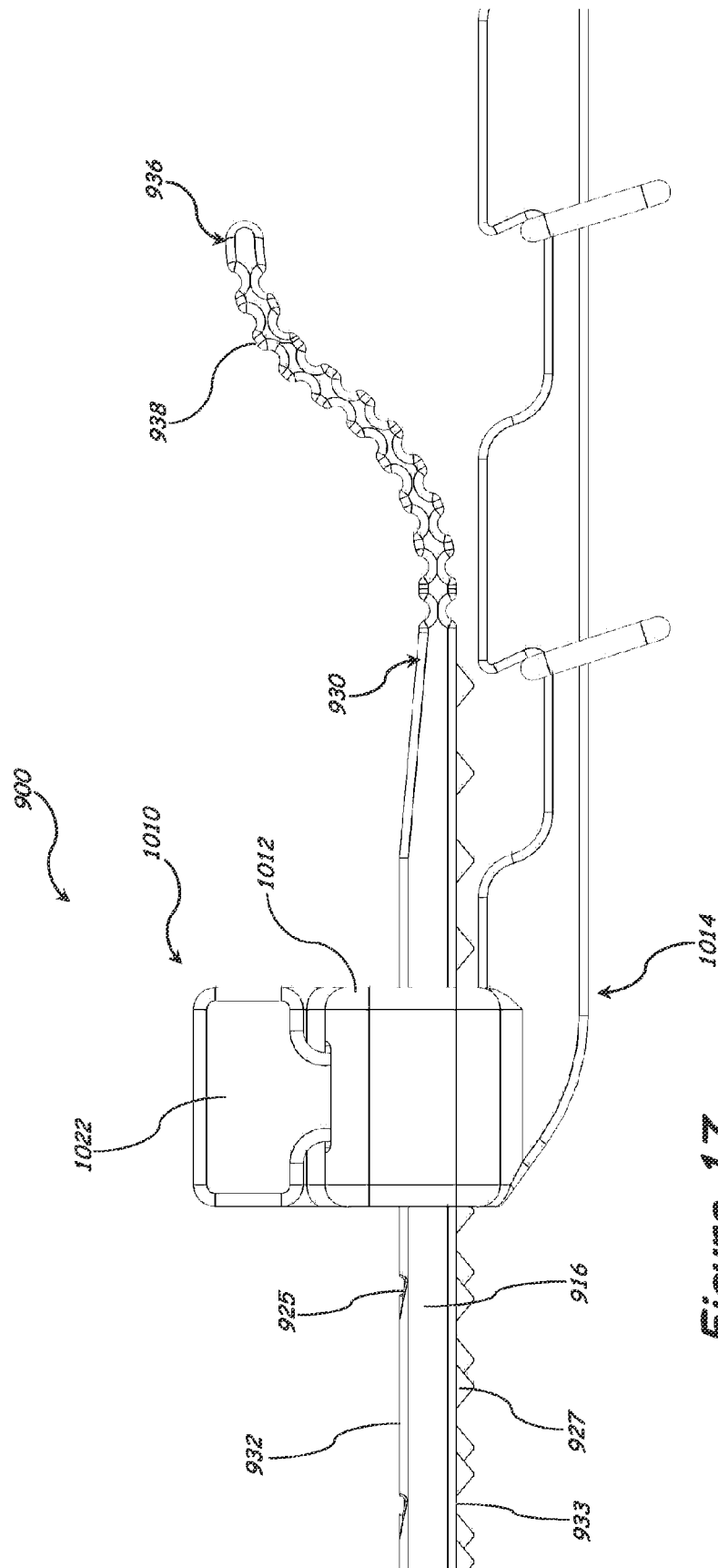
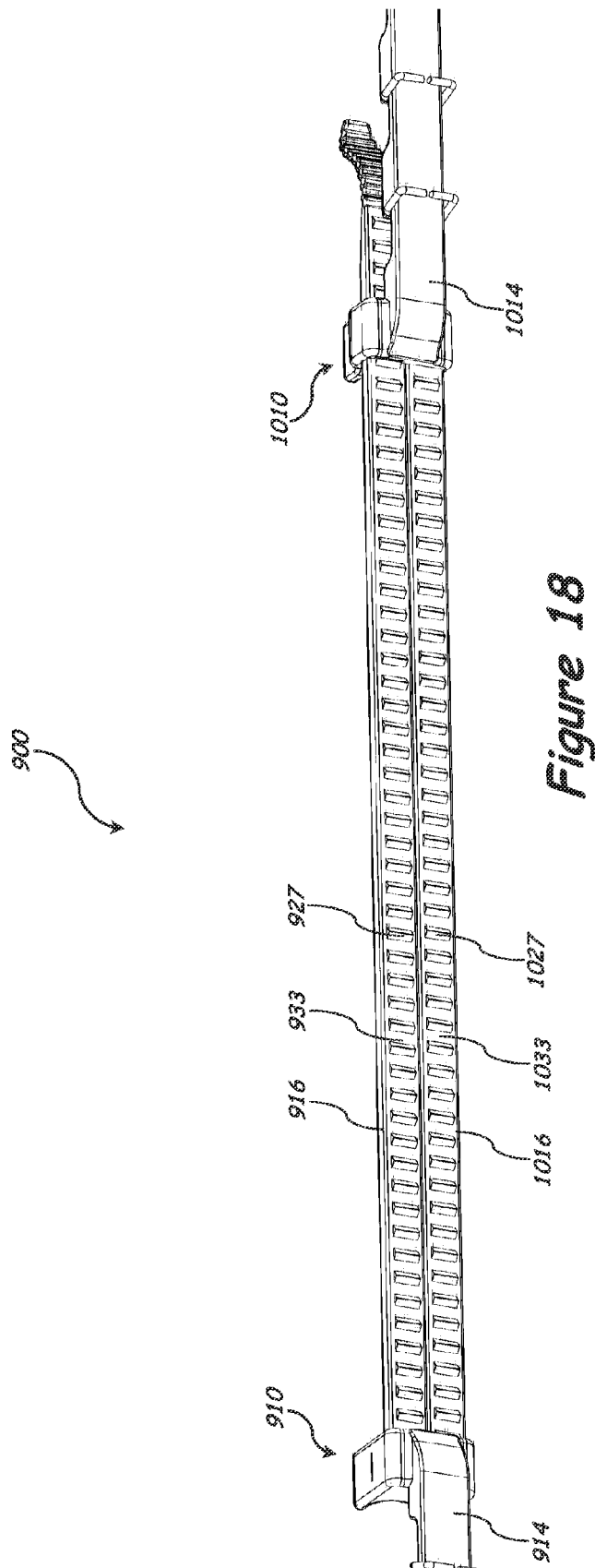
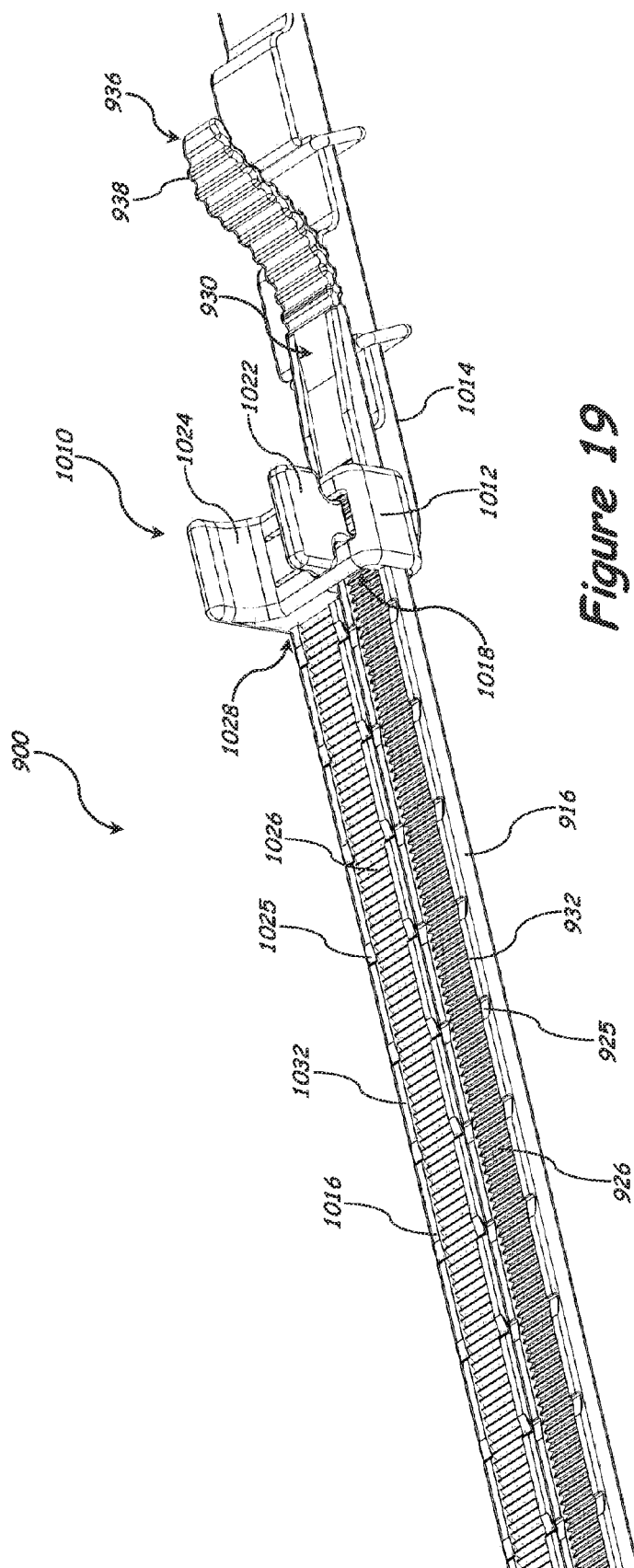
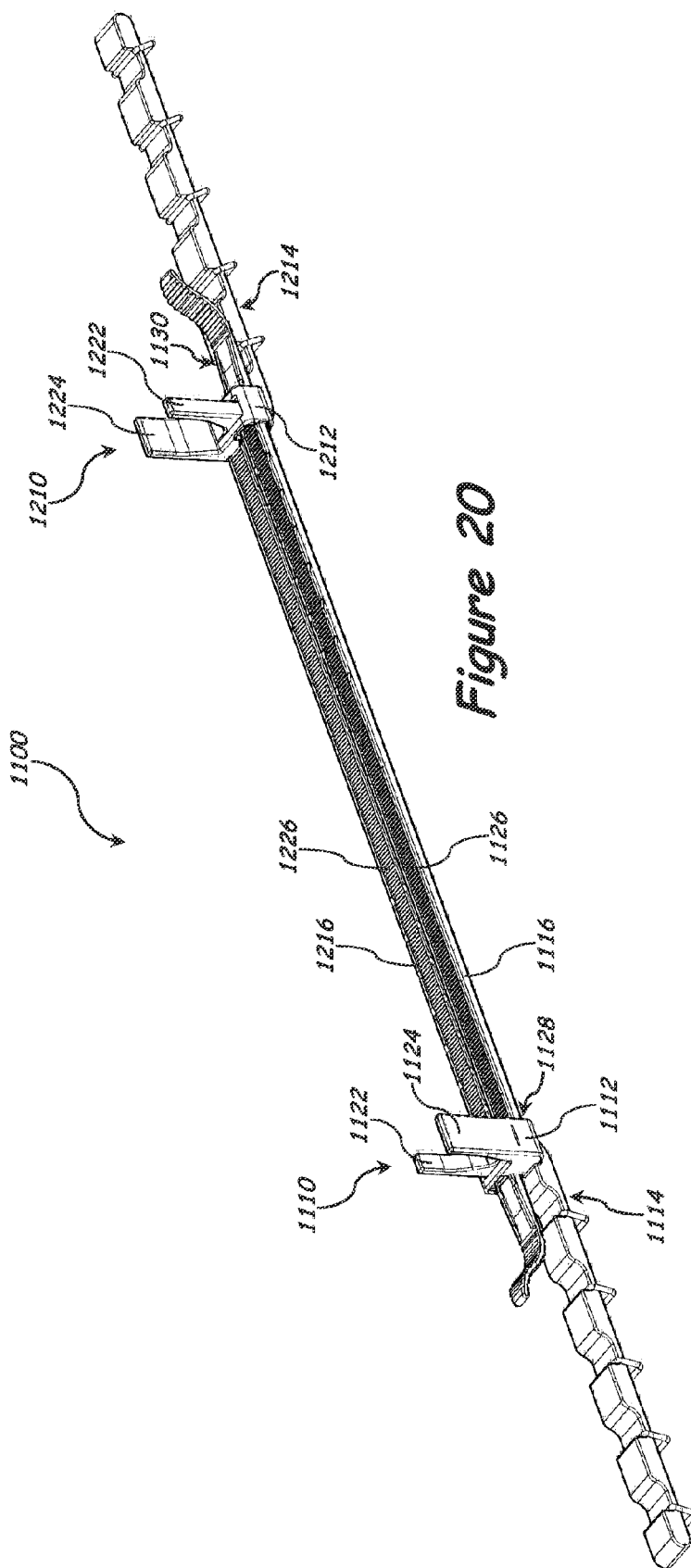


Figure 17







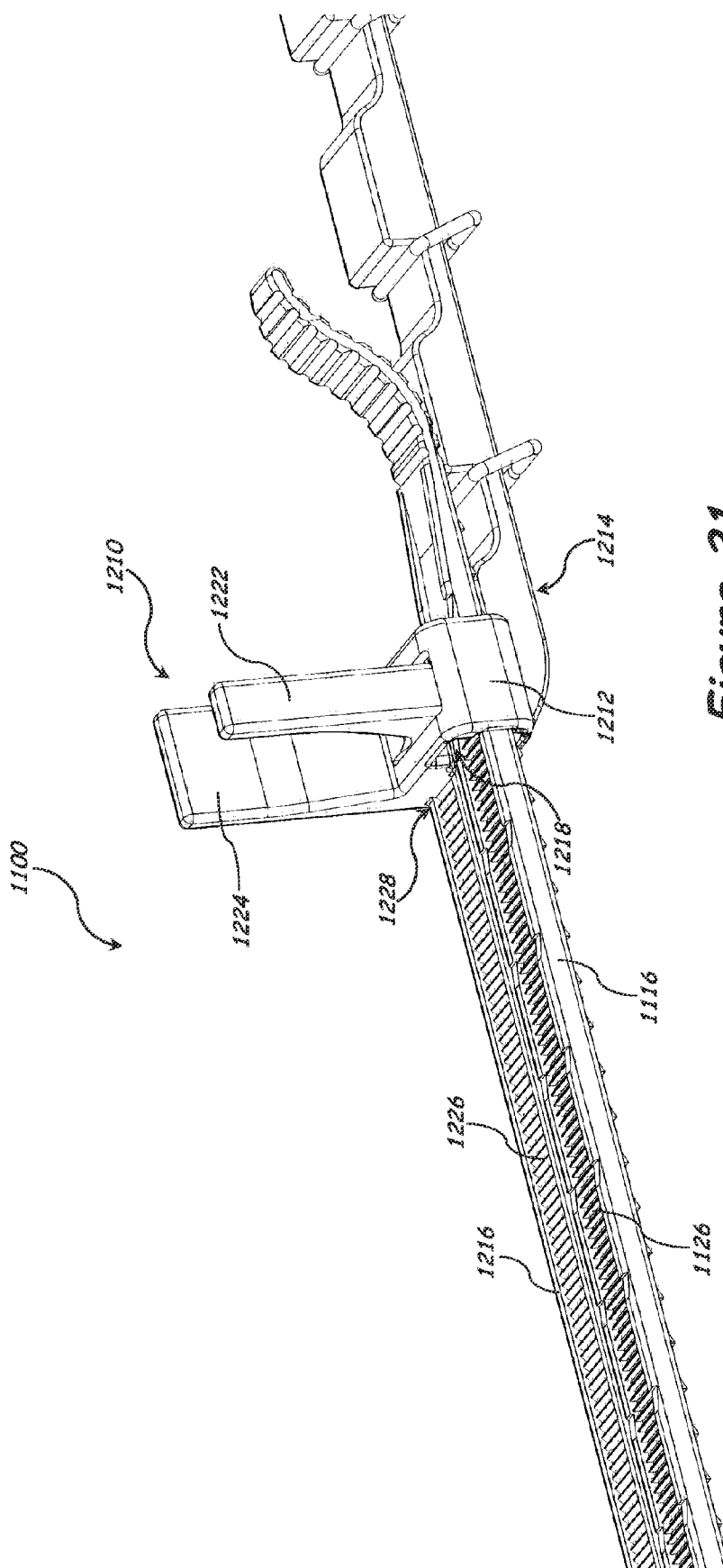


Figure 21

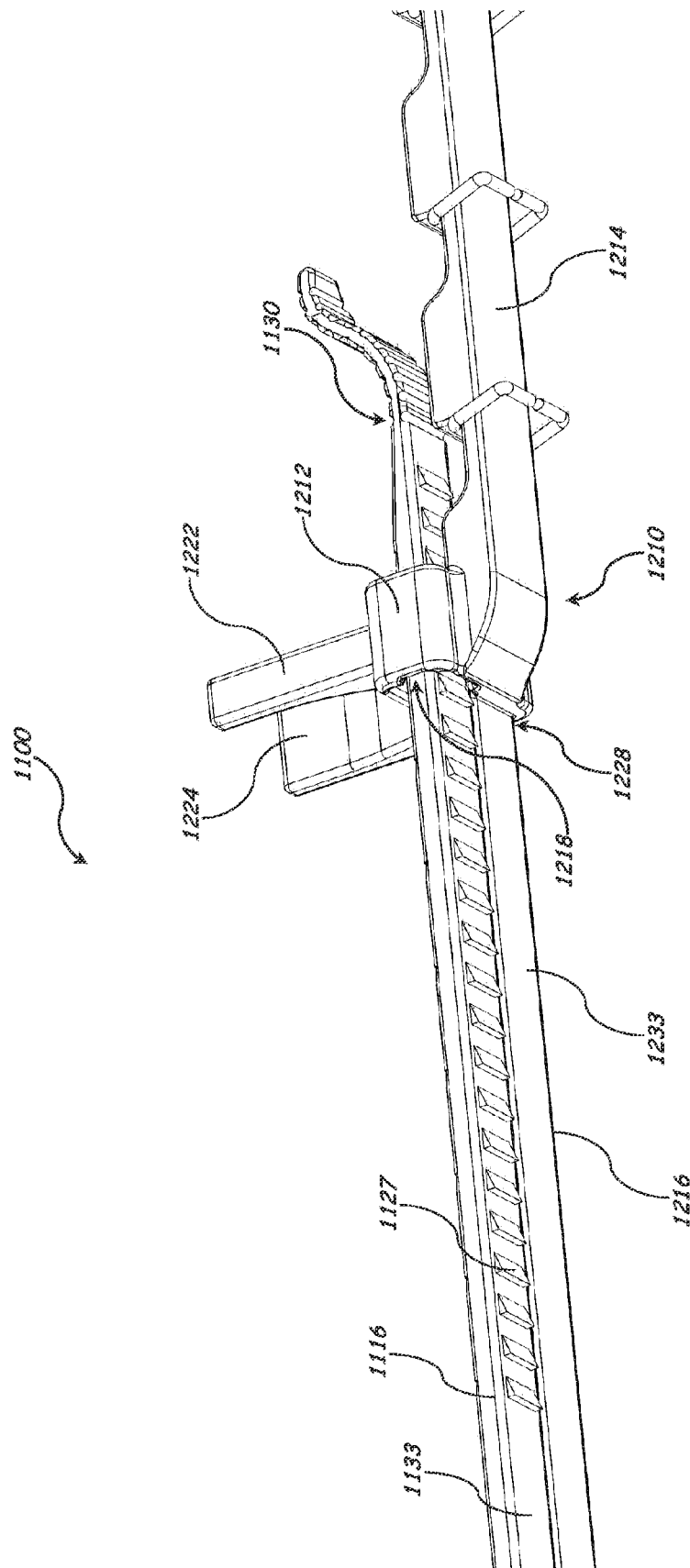
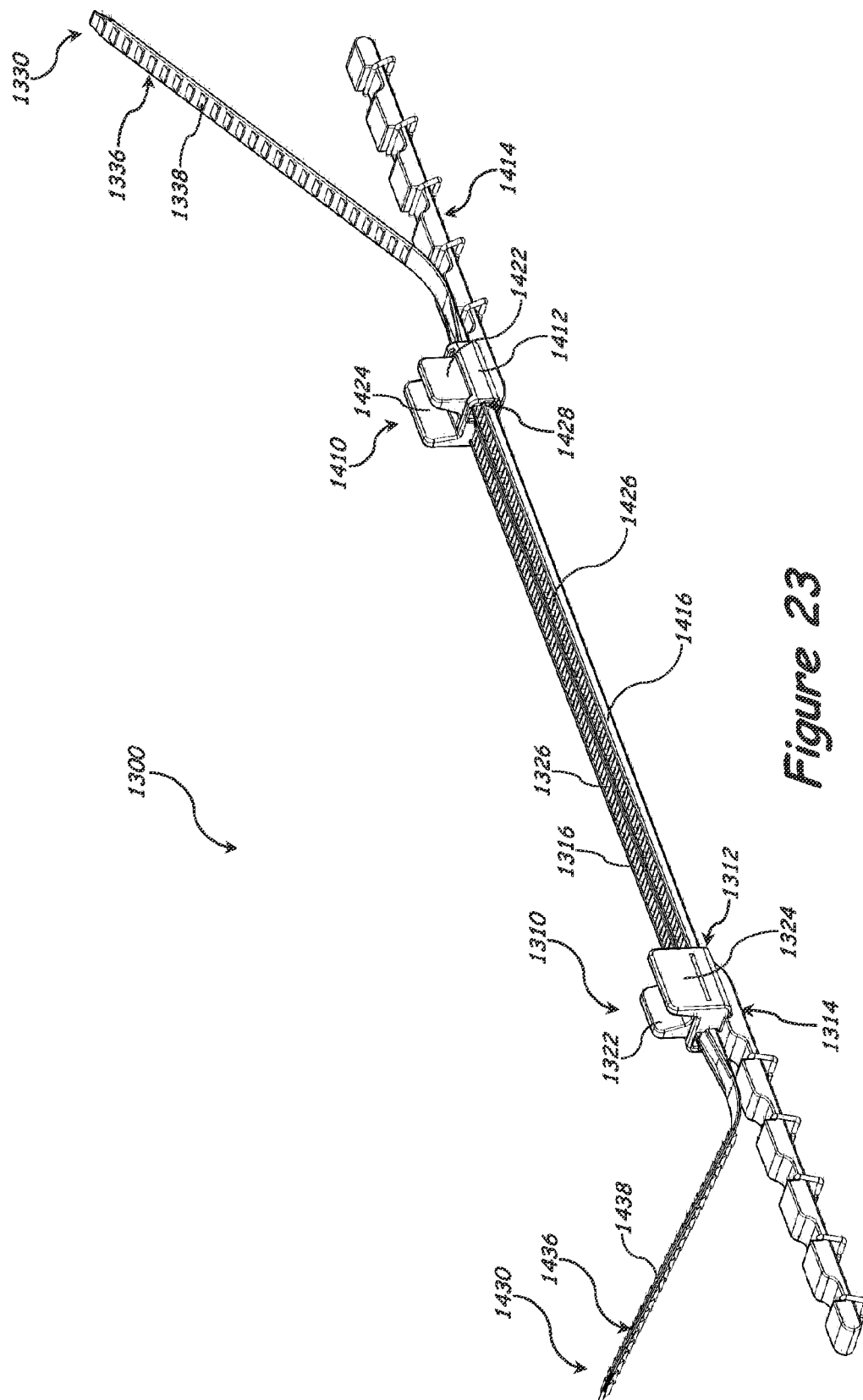
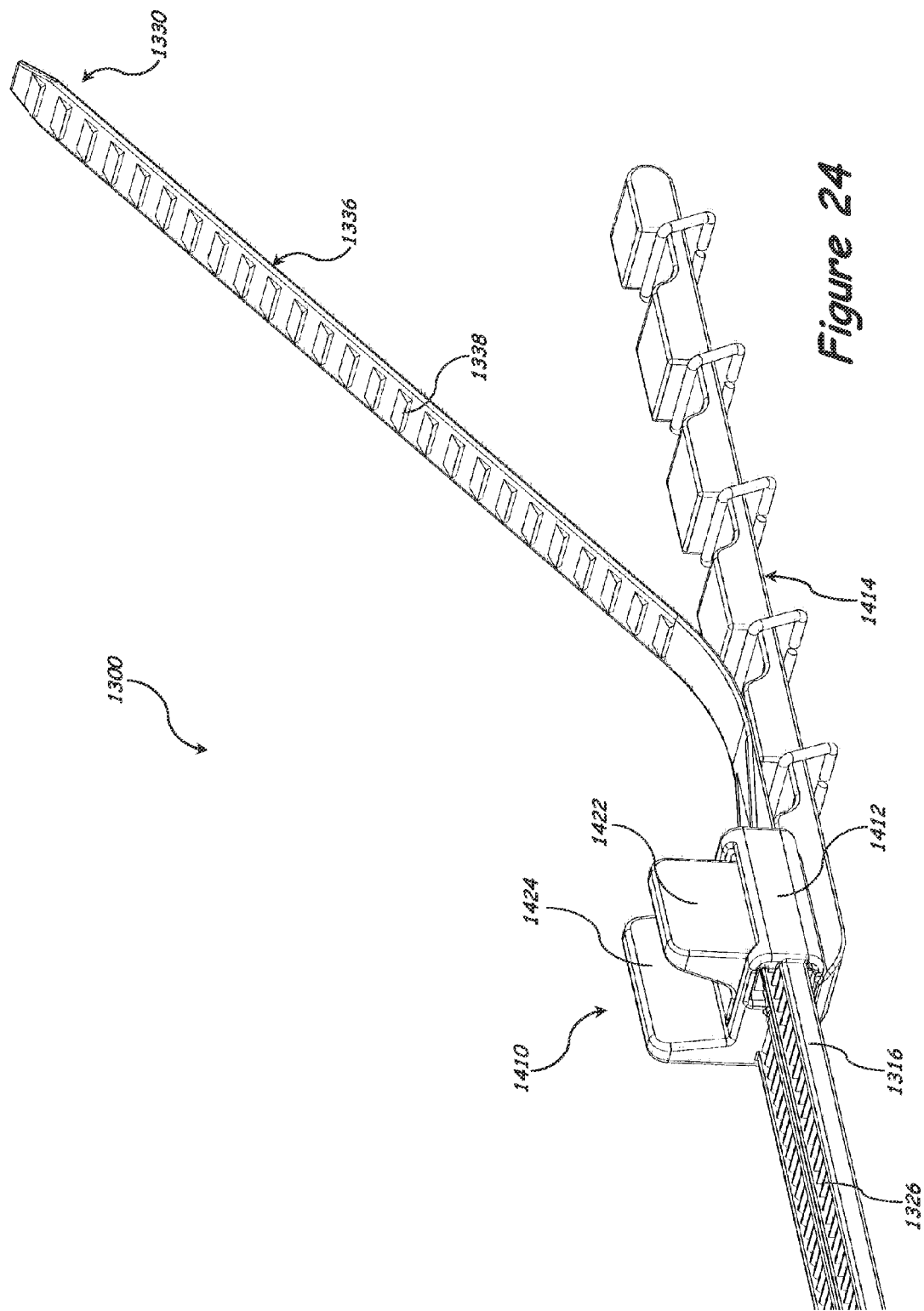


Figure 22





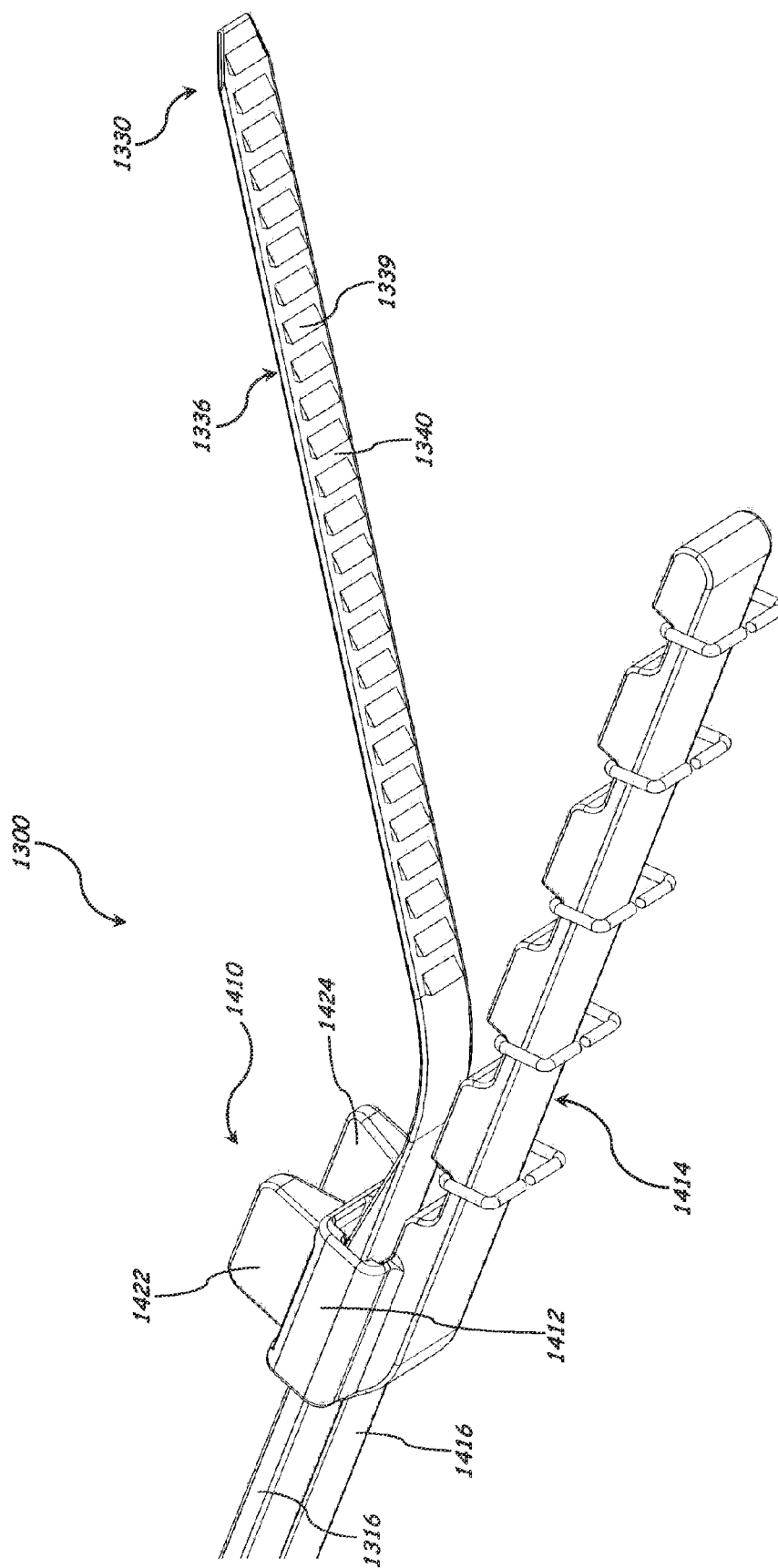


Figure 25

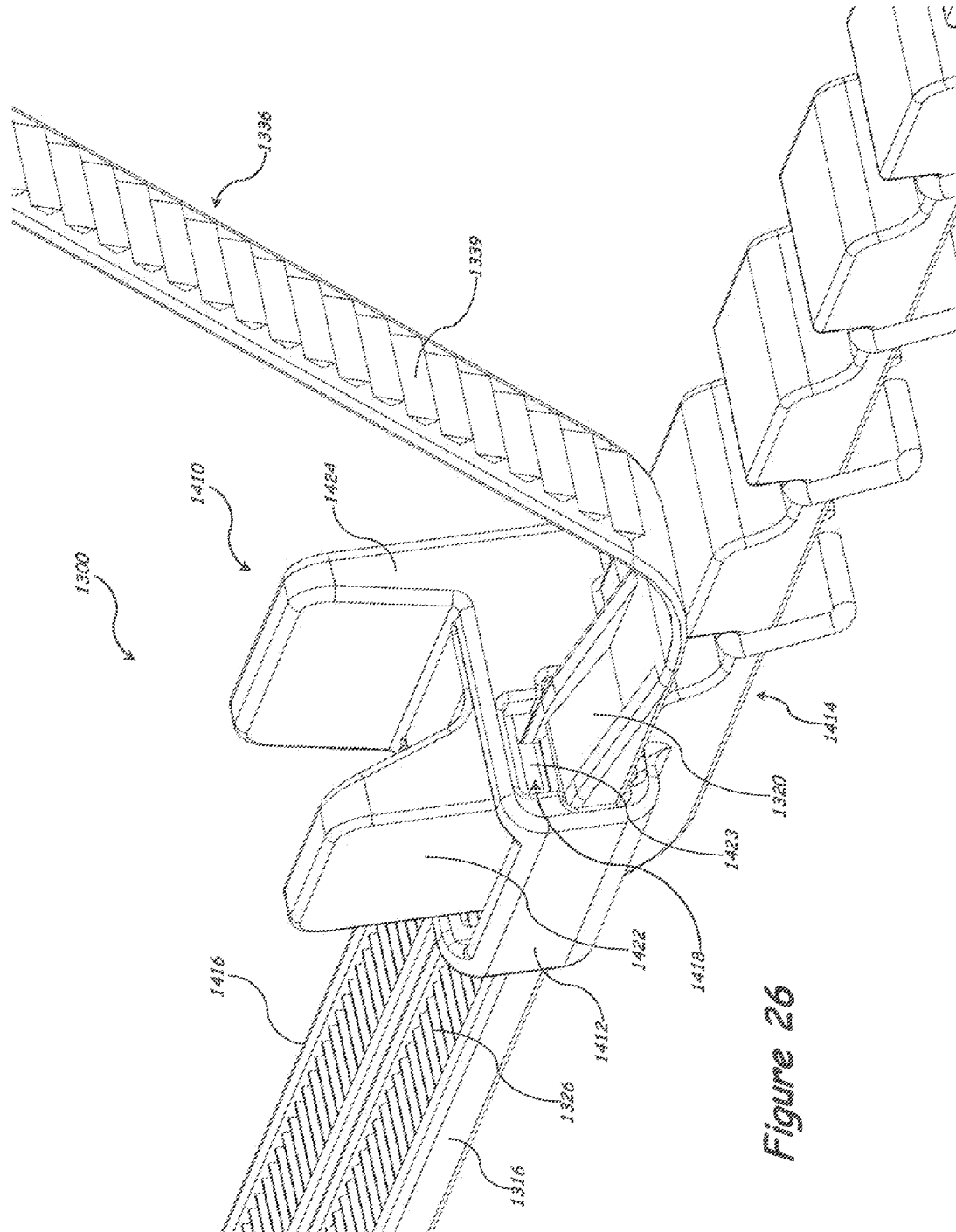


Figure 26

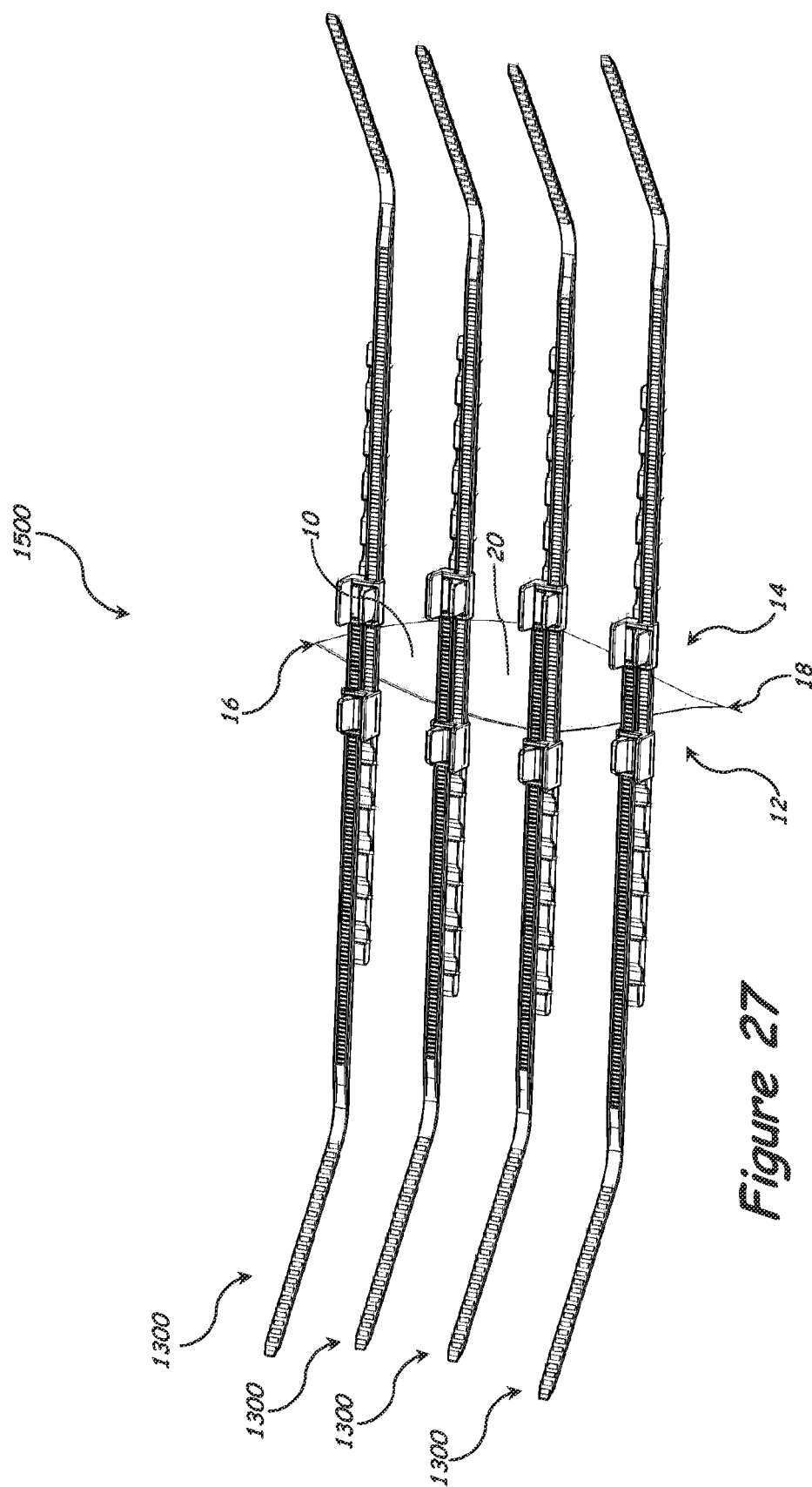


Figure 27

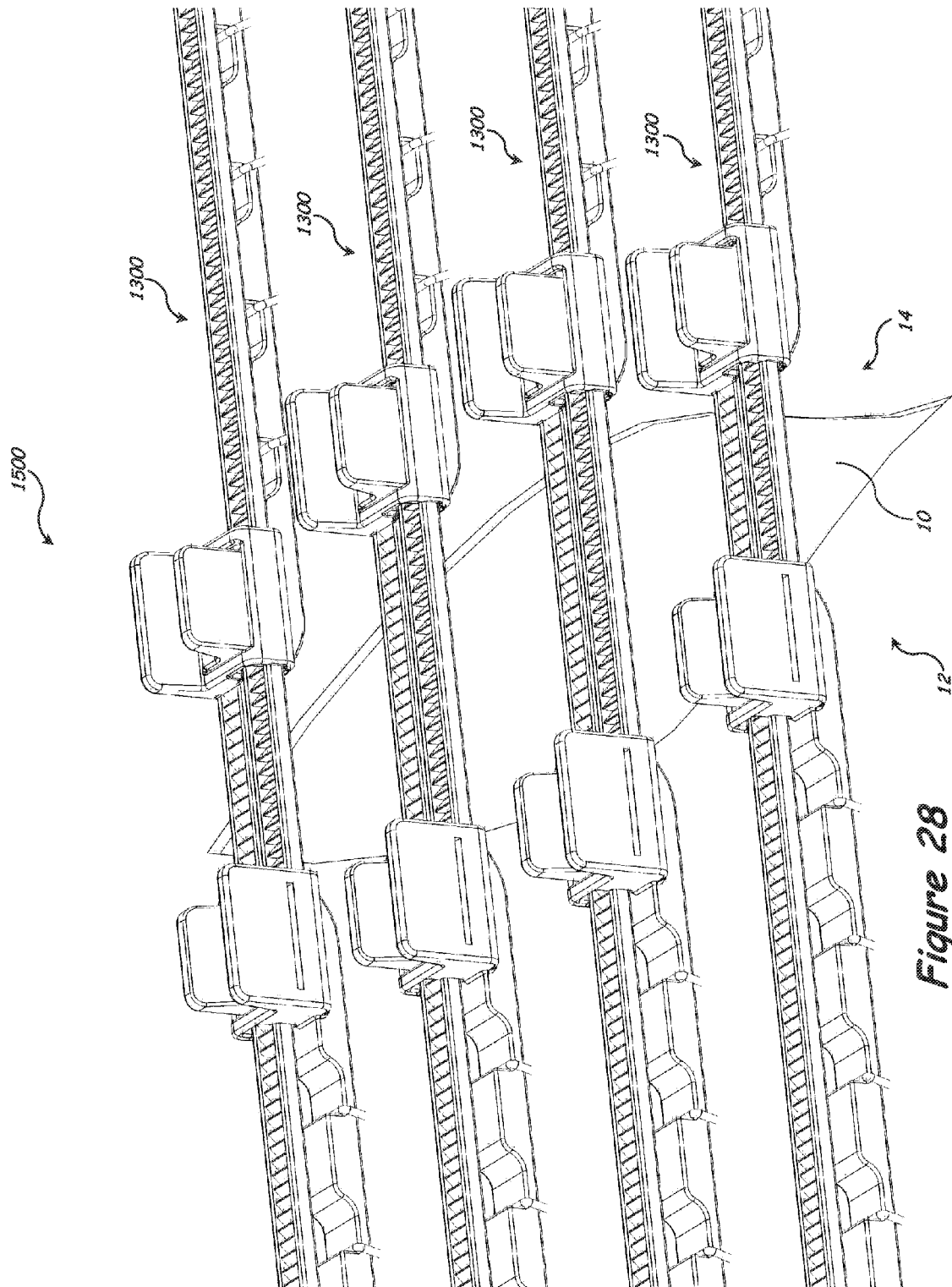


Figure 28

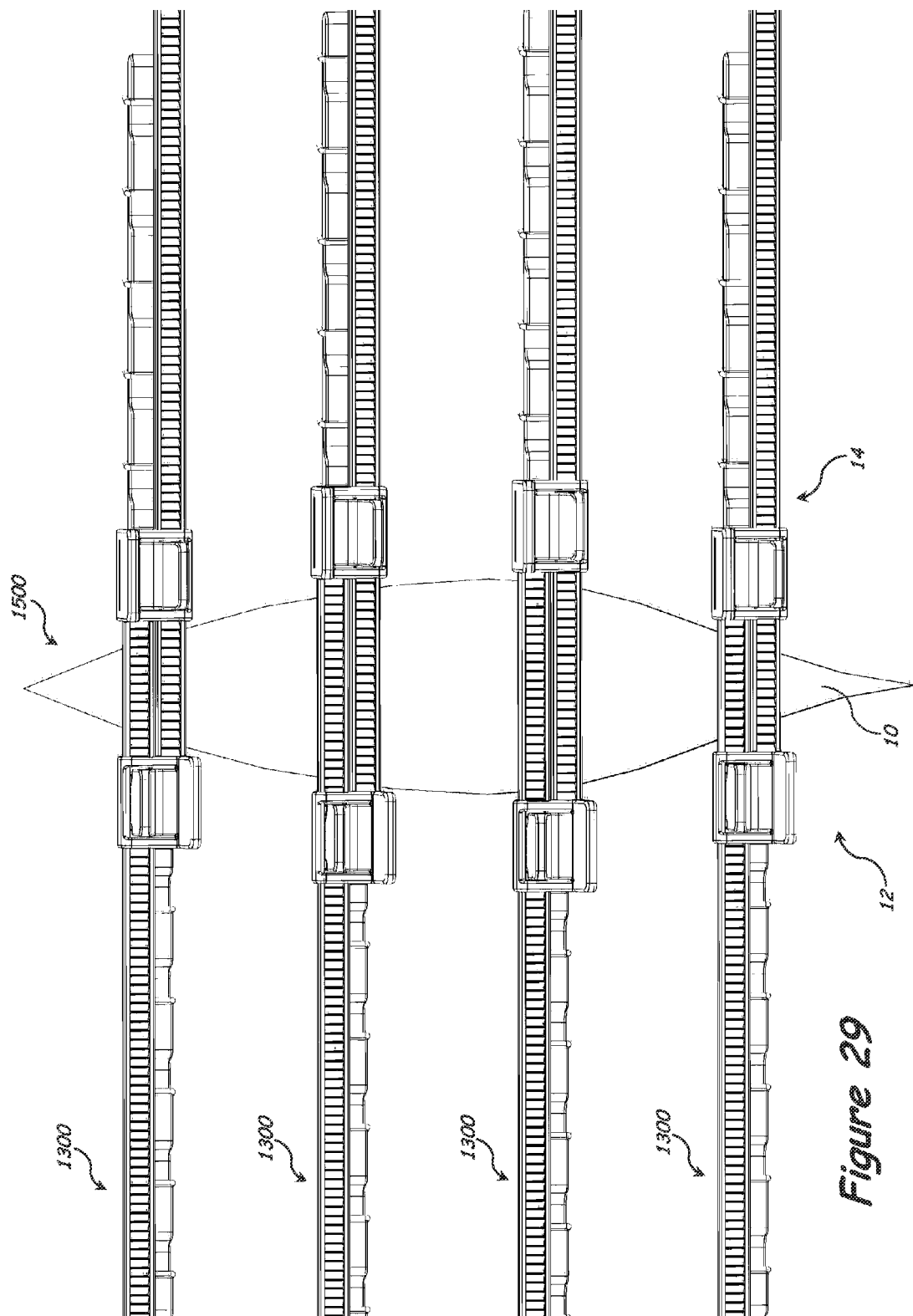


Figure 29

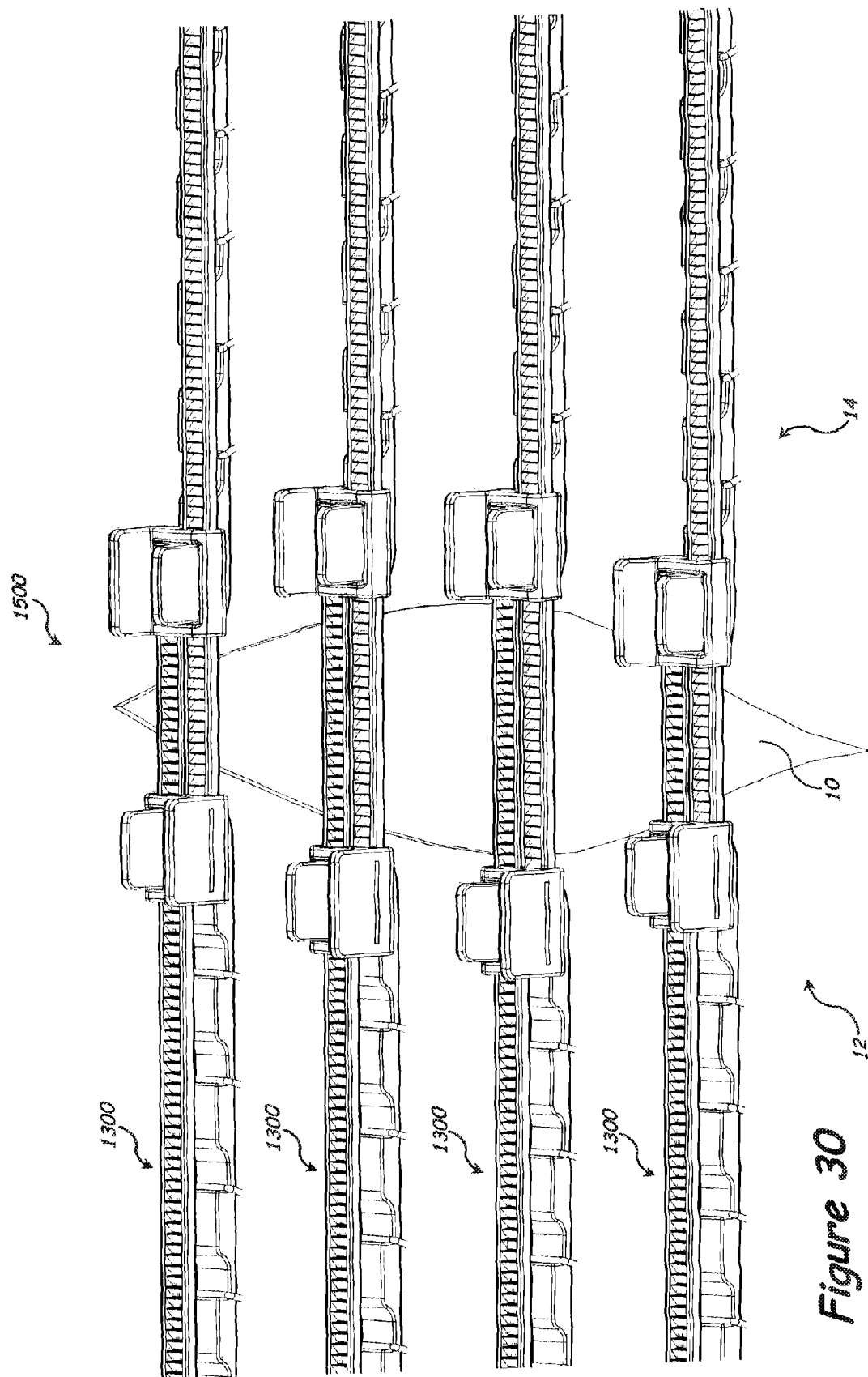
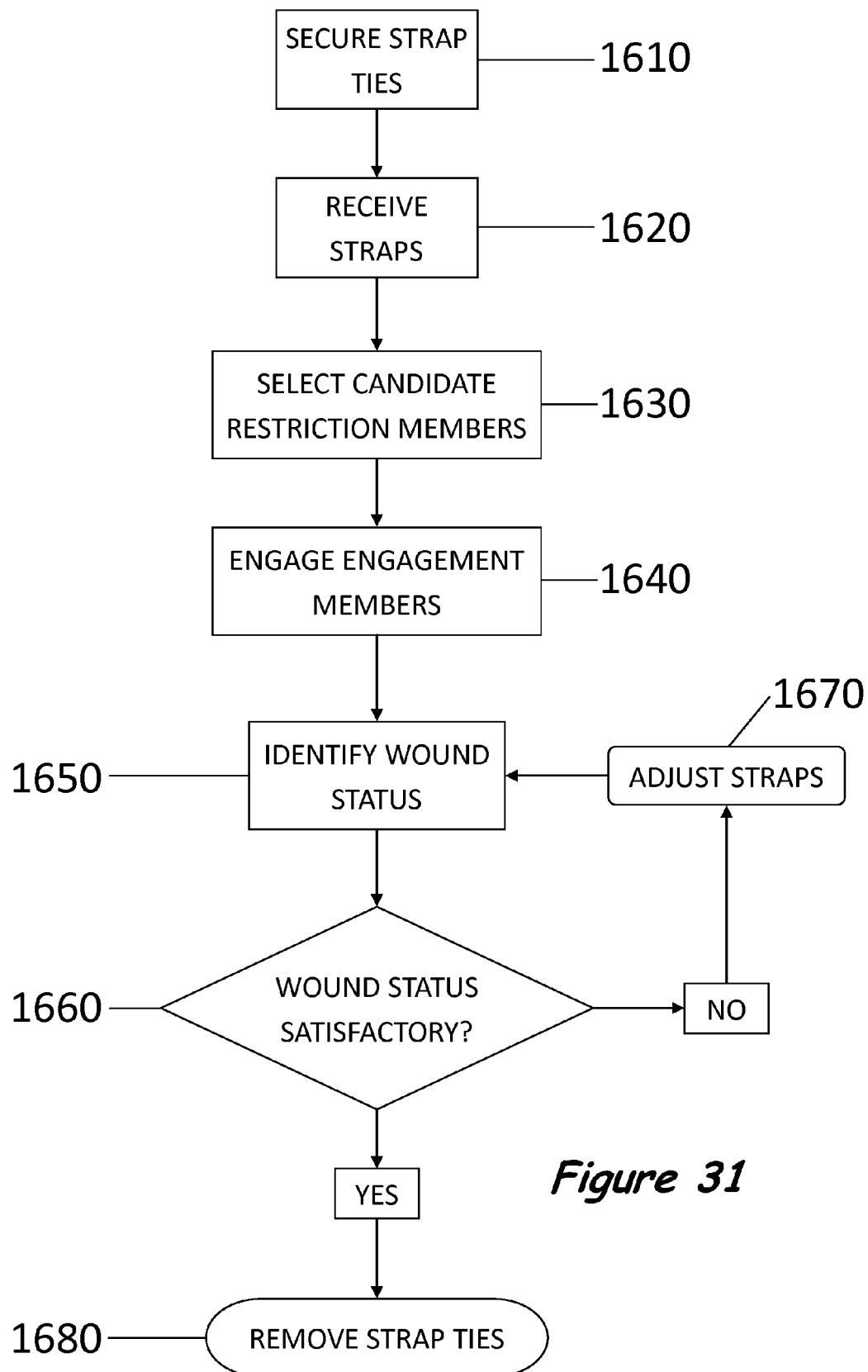


Figure 30

*Figure 31*

1 STRAP TIE SYSTEM

TECHNICAL FIELD

The present disclosure relates generally to the field of strap ties, and more specifically to apparatuses, systems, and methods relating to strap ties.

BACKGROUND

Wounds, such as cuts and lacerations in skin and flesh, are often difficult to close in order to properly treat and heal the wound. Bandages may be used to cover a wound. Wounds may be approximated (i.e., edges of wounds drawn together) using sutures, staples, clips, or topical adhesives. Over time, a wound and/or tissue associated with the wound may retract, reopen, or otherwise lose structural integrity. In some cases, clinical/surgical facilities are not readily accessible for treating a wound.

SUMMARY

According to an aspect of the present disclosure, a strap tie assembly includes a first strap tie including a first base, a first body, and a first strap extending from the first body. The first base is configured to be disposed adjacent to a first portion of skin. The first body includes a first opening and a first engagement member disposed within the first opening. The first strap includes a first proximal end attached to the first body, a first distal end opposite the first proximal end, and a plurality of first movement restriction members disposed along a surface of the first strap. The strap tie assembly also includes a second strap tie including a second base, a second body, and a second strap extending from the second body. The second base is configured to be disposed adjacent to a second portion of skin. The second body includes a second opening and a second engagement member disposed within the second opening. The second strap includes a second proximal end attached to the second body, a second distal end opposite the second proximal end, and a plurality of second movement restriction members disposed along a surface of the second strap. The first opening is configured to receive the second strap, and the first engagement member is configured to engage one of the plurality of second movement restriction members of the second strap to prevent translation of the second strap away from the first body. The second opening is configured to receive the first strap, and the second engagement member is configured to engage one of the plurality of first movement restriction members of the first strap to prevent translation of the first strap away from the second body.

According to another aspect of the present disclosure, a method of attaching a strap tie system includes detachably securing a first strap tie adjacent to a first portion of skin. The first strap tie includes a first body, a first strap extending from the first body, and a first base extending from the first body. The first body includes a first opening configured to receive a strap and a first engagement member disposed within the first opening. The first strap includes a plurality of first movement restriction members. The method includes detachably securing a second strap tie adjacent to a second portion of skin. The second strap tie includes a second body, a second strap extending from the second body, and a second base extending from the second body. The second body includes a second opening configured to receive a strap and a second engagement member disposed within the second opening. The second strap includes a plurality of second movement restriction members. The method includes receiving the first strap in the

2

second opening. The method includes receiving the second strap in the first opening. The method includes engaging the first engagement member with a candidate second movement restriction member of the second plurality of movement restriction members to prevent translation of the second strap away from the first body. The method includes engaging the second engagement member with a candidate first movement restriction member of the first plurality of movement restriction members to prevent translation of the first strap away from the second body. The candidate first movement restriction member and the candidate second movement restriction member are selected to apply an even amount of force on either side of a wound between the first portion of skin and the second portion of skin.

According to yet another aspect of the present disclosure, a strap tie for securing a wound includes a body, an engagement member, a strap extending from the body, and a base extending from the body. The body includes an opening configured to receive a strap of a remote strap tie. The engagement member is disposed within the opening and configured to engage one of a plurality of movement restriction members of a remote strap tie in order to prevent translation of the remote strap tie away from the body. The strap includes a proximal end attached to the body, a distal end opposite the proximal end, and a plurality of movement restriction members configured to be engaged by an engagement member of a remote strap tie. The base is configured to be disposed adjacent to a portion of skin.

Some or all of the systems, components, and subcomponents of the present disclosure can be single-use or disposable. Also some or all of the systems, components, and subcomponents of the present disclosure can be made of a unitary construction (formed from a single piece of metal, plastic, or other material) or unitary modular construction (plurality of components and/or subcomponents permanently connected by standard means, such as welding or soldering), or of modular construction (plurality of components and/or subcomponents removably connected by standard means, such as threading or snap-fitting).

These and other features of various embodiments can be understood from a review of the following detailed description in conjunction with the accompanying drawings.

It is to be understood that both the foregoing general description and the following detailed description are explanatory and are not restrictive of the present disclosure, as claimed.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of an embodiment of a strap tie assembly.

FIG. 2 is a perspective view of an embodiment of a strap tie assembly having an extended base portion.

FIG. 3 is a perspective view of an embodiment of the strap tie assembly of FIG. 2 in an adjusted configuration in which a first strap tie and a second strap tie have been drawn more closely together.

FIG. 4 is a detailed perspective view of an embodiment of various components of the strap tie assembly of FIG. 2 as shown in the configuration of FIG. 3.

FIG. 5 is a detailed side view of an embodiment of various components of the strap tie assembly of FIG. 2 as shown in the configuration of FIG. 3.

FIG. 6 is a perspective end view of an embodiment of a strap tie and various components of the strap tie including a body, a strap, openings, engagement members, and an attachment member.

3

FIG. 7 is a detailed perspective view of an embodiment of a strap tie in which the strap tie has received a remote strap.

FIG. 8 is a perspective view of an embodiment of a strap tie assembly in which each strap tie includes a loop handle and a pair of openings disposed in a side-by-side configuration.

FIG. 9 is a detailed perspective view of an embodiment of the strap tie assembly of FIG. 8.

FIG. 10 is a perspective view of an embodiment of a strap tie assembly in which each strap tie includes a loop handle and a pair of bodies for receiving a strap of another strap tie.

FIG. 11 is a top view of an embodiment of the strap tie assembly of FIG. 10.

FIG. 12 is a perspective view of an embodiment of a strap tie assembly in which each strap tie includes an actuatable engagement member and a lobed handle.

FIG. 13 is an end perspective view of an embodiment of the lobed handle of FIG. 12.

FIG. 14 is a detailed perspective view of an embodiment of the strap tie assembly of FIG. 12 illustrating the engagement between each strap tie of the strap tie assembly.

FIG. 15 is a detailed perspective view of an embodiment of the strap tie assembly of FIG. 12 in which an actuatable engagement member has engaged a strap of another strap tie.

FIG. 16 is a perspective view of an embodiment of a strap tie assembly in which each strap includes a handle end with protrusions/indentations.

FIG. 17 is a detailed side view of an embodiment of a strap tie of the strap tie assembly of FIG. 16 illustrating various features of the straps.

FIG. 18 is a bottom perspective view of an embodiment of the strap tie assembly of FIG. 16 illustrating various features of the straps.

FIG. 19 is a detailed top perspective view of an embodiment of the strap tie assembly of FIG. 16 in the vicinity of a strap tie illustrating various features of the strap ties and the engagement between the strap ties.

FIG. 20 is a perspective view of an embodiment of a strap tie assembly in which each strap tie body includes an elongated engagement member.

FIG. 21 is a detailed perspective view of an embodiment of a strap tie of the strap tie assembly of FIG. 20.

FIG. 22 is a detailed bottom perspective view of an embodiment of the strap tie assembly of FIG. 20 illustrating various features of the engagement mechanism and straps of the strap tie assembly.

FIG. 23 is a perspective view of an embodiment of a strap tie assembly in which each of the straps includes an elongated handle region.

FIG. 24 is a detailed perspective view of an embodiment of a strap tie of the strap tie assembly of FIG. 23 illustrating features of the strap tie.

FIG. 25 is a detailed bottom perspective view an embodiment of a strap tie of the strap tie assembly of FIG. 23 illustrating features of the strap tie.

FIG. 26 is a detailed perspective view of an embodiment of a strap tie of the strap tie assembly of FIG. 23 illustrating features of the engagement mechanism and the elongated handle region.

FIG. 27 is a perspective view of an embodiment of a grouping of multiple strap tie assemblies.

FIG. 28 is a detailed perspective view of an embodiment of the strap ties of the grouping of FIG. 27.

FIG. 29 is a top view of an embodiment of the grouping of FIG. 27.

FIG. 30 is a side perspective view of the grouping of FIG. 27.

4

FIG. 31 is a block diagram of an embodiment of a method of securing a wound with an even amount of force applied across the wound using a strap tie assembly.

DETAILED DESCRIPTION

The following detailed description and the appended drawings describe and illustrate various strap tie systems, methods, and components. The description and drawings are provided to enable one of skill in the art to make and use one or more strap tie systems and/or components, and/or practice one or more methods. They are not intended to limit the scope of the claims in any manner.

The use of “e.g.” “etc.,” “for instance,” “in example,” and “or” and grammatically related terms indicates non-exclusive alternatives without limitation, unless otherwise noted. The use of “optionally” and grammatically related terms means that the subsequently described element, event, feature, or circumstance may or may not be present/occur, and that the description includes instances where said element, event, feature, or circumstance occurs and instances where it does not. The use of “attached” and “coupled” and grammatically related terms refers to the fixed, releasable, or integrated association of two or more elements and/or devices with or without one or more other elements in between. Thus, the term “attached” or “coupled” and grammatically related terms include releasably attaching or fixedly attaching two or more elements and/or devices in the presence or absence of one or more other elements in between. As used herein, the terms “proximal” and “distal” are used to describe opposing axial ends of the particular elements or features being described in relation to anatomical placement.

In existing solutions to treat wounds, uneven forces applied across the wound limit the efficacy of wound healing, such as by causing scars to form. The present solution provides systems, methods, and apparatuses for applying an even amount of force across a wound in order to more effectively heal the wound and limit scar formation. The present solution includes a strap tie assembly including a first strap tie and a second strap tie. The first strap tie includes a first base configured to be disposed adjacent to a first portion of skin, a first body including a first opening and a first engagement member disposed within the first opening, and a first strap extending from the first body. The first strap includes a first proximal end attached to the first body, a first distal end opposite the first proximal end, and a plurality of first movement restriction members disposed along a surface of the first strap. The second strap tie includes a second base configured to be disposed adjacent to a second portion of skin, a second body including a second opening and a second engagement member disposed within the second opening, and a second strap extending from the second body. The second strap includes a second proximal end attached to the second body, a second distal end opposite the second proximal end, and a plurality of second movement restriction members disposed along a surface of the second strap. The first opening is configured to receive the second strap, and the first engagement member is configured to engage one of the plurality of first movement restriction members of the first strap to prevent translation of the first strap away from the second body. The second opening is configured to receive the first strap, and the second engagement member is configured to engage one of the plurality of first movement restriction members of the first strap to prevent translation of the first strap away from the second body. In this way, the tie strap assembly can provide an even amount of force across a wound. The strap tie assembly may include features such as handles, grips, friction elements, etc., which

5

facilitate manipulation of the strap tie assembly in environments where blood, oil (e.g., lipids), or other fluids could impair manipulation. While the present disclosure illustrates use of the strap tie assembly in the context of wound closure, in various embodiments, strap tie assemblies and components thereof may be used in various applications, including but not limited to general use for securing a surface or multiple surfaces; for drawing or pulling surfaces together; for securing homogenous or heterogeneous surfaces; for applying tension to a surface or multiple surfaces; etc.

Referring to FIG. 1, a perspective view of an embodiment of a strap tie assembly 100 is shown. The strap tie assembly 100 includes a first strap tie 110 and a second strap tie 210. The first strap tie 110 includes a first body 112, a first base 114, and a first strap 116. The first base 114 is configured to be disposed adjacent to a first portion of skin. Similarly, the second strap tie 210 includes a second body 212, a second base 214 configured to be disposed adjacent to a first portion of skin, and a second strap 216. In some embodiments, the second strap tie 210 can be identical to the first strap tie 110. In some embodiments, the first strap tie 110 and the second strap tie 210 are generally similar or identical, and configured to interact in a complementary fashion or an opposing fashion. Stated in another way, the components of the first strap tie 110 and the second strap tie 210 can be disposed or configured to engage each other in an identical manner and/or in a mirror image manner.

In some embodiments, the first body 112 includes a pair of first openings 118, 120. The first body 112 includes a pair of first engagement members 122, 124. The first engagement member 122 is disposed within the first opening 118 and the first engagement member 124 is disposed within the first opening 120. Similarly, the second body 212 includes a pair of second openings 218, 220. The second body 212 includes a pair of second engagement members 222, 224. The second engagement member 222 is disposed within the second opening 218 and the second engagement member 224 is disposed within the second opening 220. While the figures illustrate bodies such as first body 112 and second body 212 as including a pair of openings and a pair of engagement members, in various embodiments, various numbers of openings and engagement members may be used (e.g. 1 opening, more than 2 openings, 1 engagement member, more than 2 engagement members, etc.).

In some embodiments, an opening, such as first openings 118, 120 or second openings 218, 220, is disposed such that a path passing through the opening is generally parallel to a longitudinal axis defined by a strap, such as the first strap 116 or the second strap 216. In some embodiments, an opening, such as first openings 118, 120 or second openings 218, 220, is disposed such that a face of the opening is perpendicular to the longitudinal axis defined by the strap. For the sake of clarity, the two openings will be referred to as upper and lower openings (e.g. first lower opening 118, first upper opening 120, second lower opening 218, second upper opening 220), based on the frame of reference shown in FIG. 1, though the strap tie assembly 100 may be configured to be disposed in various orientations based on various frames of reference. For example, as shown in FIG. 1, the first lower opening 118 is disposed or otherwise defined within a first portion of the first body 112 proximate to the first base 114. Similarly, the second lower opening 218 is disposed within a second portion of the second body 212 proximate to the second base 214. The first upper opening 120 is disposed or otherwise defined within a second portion of the first body 112 farther away from the first base 114 relative to the first lower opening 118. Similarly, the second upper opening 220 is disposed or oth-

6

erwise defined within a second portion of the second body 212 farther away from the second base 214 relative to the second lower opening 218. In some embodiments, the first strap 116 extends from a third portion of the first body 112 that is positioned between the first portion and the second portion of the first body 112. Similarly, in some embodiments, the second strap 216 extends from a third portion of the second body 212 that is positioned between the first portion and the second portion of the second body 212. In some embodiments, the third portion of the second body 212 separates the first portion of the second body 212 from the second portion of the second body 212.

In some embodiments, the plurality of movement restriction members (e.g., movement restriction members 126, movement restriction members 226, etc.) includes a plurality of ridges. The ridges may define a plurality of grooves (e.g., recesses, cavities, etc.). In some embodiments, the plurality of movement restriction members (e.g., movement restriction members 126, movement restriction members 226, etc.) includes a plurality of holes; a corresponding engagement member (e.g., engagement member 122, etc.) may include a hook or other structure configured to engage a hole.

Referring back to FIG. 1, the first strap 116 extends from the first body 112. The first strap 116 includes a first proximal end 128 attached to the first body 112 and a first distal end 130 opposite the first proximal end 128. The first strap 116 includes a plurality of first movement restriction members 126 disposed along a surface 132 of the first strap 116. Similarly, the second strap tie 210 includes a second strap 216 extending from the second body 212. The second strap 216 includes a second proximal end 228 attached to the second body 212 and a second distal end 230 opposite the second proximal end 228. The second strap 216 includes a plurality of second movement restriction members 226 disposed along a surface 232 of the second strap 216. Additional details pertaining to the interactions between the first engagement member and the first movement restriction members and the second engagement member and the second movement restriction members are provided below.

Each of the pair of first openings 118, 120 is configured to receive the second strap 216. Each of the pair of first engagement members 122, 124 is configured to engage one of the plurality of second movement restriction members 226 of the second strap 216. For example, as shown in FIG. 1, the second strap 216 has been received through the first opening 120. The first engagement member 124 has engaged one of the plurality of second movement restriction members 226.

The engagement between an engagement member and a movement restriction member, such as between the first engagement member 124 and the second movement restriction member 226, can prevent translation of the second strap 216 away from the first body 112. For example, the engagement may only allow the second strap 216 to move in a single direction relative to the first body 112, such that the second body 212 can only be drawn towards the first body 112 as the second strap 216 is received through one of the first openings 118, 120.

Each of the pair of second openings 218, 220 is configured to receive the first strap 116. Each of the pair of second engagement members 222, 224 is configured to engage one of the plurality of first movement restriction members 126 of the first strap 116. For example, as shown in FIG. 1, the first strap 116 has been received through the second opening 218. The second engagement member 222 has engaged one of the plurality of first movement restriction members 126.

In some embodiments, a strap (e.g., first strap 116, second strap 216, etc.) is received by a corresponding opening by first

passing the distal end of the strap through the corresponding opening, followed by passing the length of the strap through the opening up to a particular movement restriction member.

Similar to the engagement between the first engagement members **122**, **124** and the second movement restriction members **226**, the engagement between the second engagement members **222**, **224** and the first movement restriction members **126** can prevent translation of the first strap **116** away from the second body **212**. For example, the engagement between the first engagement members **122**, **124** and the second movement restriction members **226** may only allow the first strap **116** to move in a single direction relative to the second body **212**. As such, the first body **112** can only be drawn towards the second body **212** as the first strap **116** is received through one of the second openings **218**, **220**. Stated in other words, such an engagement prevents translation of the first strap **116** away from the second body **212** by preventing a motion between the first strap **116** and the second body **212** in which the first strap tie **110** and the second strap tie **210** are separated and/or in which the first body **112** and the second body **212** are drawn away from each other.

Similarly, the engagement between the second engagement members **222**, **224** and the first movement restriction members **126** may only allow the second strap to move in a single direction relative to the second body **212**. As such, the second body **212** can only be drawn towards the first body **112** as the second strap **216** is received through one of the first openings **118**, **120**. Stated in other words, such an engagement prevents translation of the second strap **216** away from the first body **112** by preventing a motion between the second strap **216** and the first body **112** in which the second strap tie **210** and the first strap tie **110** are separated and/or in which the first body **112** and the second body **212** are drawn away from each other.

In some embodiments, an engagement member such as engagement member **222** is configured to removably engage a corresponding movement restriction member **126**. For example, the engagement member **222** may be mechanically coupled to a release member that disengages the engagement member **222** from the movement restriction member **126** when the release member is actuated.

In some embodiments, the first strap tie **110** includes a first handle **136** disposed at the first distal end **130** of the first strap **116**. As shown in FIG. 1, the first handle **136** has a tapered shape (e.g., tapers to a thin shape at the first distal end **130**), facilitating the passing of the first strap **116** through an opening such as the second opening **218**. In some embodiments, the first handle **136** is detachably coupled to the first strap **116**.

In some embodiments, similar to the first strap tie **110**, the second strap tie **210** includes a second handle **236** disposed at the second distal end **230** of the second strap **216**. As shown in FIG. 1, the second handle **236** has a tapered shape (e.g., tapers to a thin shape at the distal end **230**), facilitating the passing of the second strap **216** through an opening such as the first opening **120**. In some embodiments, the second handle **236** is detachably coupled to the second strap **216**.

Handles, such as the first handle **136** and the second handle **236** may include a high-friction surface, such as a surface with ridges or other protrusions, facilitating gripping of the handles by a user. Handles may include a grip shaped to conform to the hand of a user, such as a pistol grip. Handles may be integrally formed with associated straps, such as being extruded as a single piece. Handles may be detachably coupled by having complementary mating features with associated straps. For example, a handle may include a male protrusion configured to engage a female receiver provided

on a distal end of a corresponding strap, or vice versa. A strap may be provided with a universal receiver or a universal protrusion, allowing the strap to be engaged to a variety of handles.

In some embodiments, the first strap tie **110** includes an attachment member configured to attach the first strap tie **110** to a portion of skin (e.g., a first portion of skin along a first side of a wound), such as an attachment member **134** disposed proximate to the base **114**. The attachment member **134** may secure the strap tie **110** to the portion of skin. In some embodiments, the attachment member **134** may detachably secure, attach, or otherwise couple the strap tie **110** to the portion of skin. For example, the attachment member **134** can be an adhesive or staple that is removable and therefore can detachably secure the strap tie **110** to the portion of the skin. The attachment member **134** can secure the strap tie **110** temporarily. In some embodiments, the strap tie **110** can be permanently secured to the portion of skin (e.g., detachably secured, removably secured, temporarily secured, permanently secured, etc.). As shown in FIG. 1, the attachment member **134** is provided as a staple. In various embodiments, the attachment member **134** may be provided using various implements (e.g., staples, hooks, adhesives, etc.).

Similar to the first strap tie **110**, in some embodiments, the second strap tie **210** includes an attachment member configured to attach the second strap tie **210** to a portion of skin (e.g., a second portion of skin along a second side of a wound), such as an attachment member **234** disposed proximate to the base **214**. The attachment member **234** may secure the strap tie **210** to the portion of skin. In some embodiments, the attachment member **234** may detachably secure, attach, or otherwise couple the strap tie **210** to the portion of skin. For example, the attachment member **234** can be an adhesive or staple that is removable and therefore can detachably secure the strap tie **210** to the portion of skin. The attachment member **234** can secure the strap tie **210** temporarily. In some embodiments, the strap tie **210** can be permanently secured to the portion of skin (e.g., detachably secured, removably secured, temporarily secured, permanently secured, etc.). As shown in FIG. 1, the attachment member **234** is provided as a staple. In various embodiments, the attachment member **234** may be provided using various implements (e.g., staples, hooks, adhesives, etc.).

In some embodiments, as shown in FIG. 1, when the first strap **116** has been received through the second opening **218** and the second strap **216** has been received through the first opening **120**, the first strap **116** and the second strap **216** are disposed substantially parallel to each other. In some embodiments, straps are disposed substantially parallel when they follow a similar path while being disposed proximate to each other when the strap ties **110**, **210** are engaged. For example, a plane passing through the first strap **116** that is perpendicular to the first movement restriction members **126** of the first strap **116** may be parallel to a plane passing through the second strap **216** that is perpendicular to the second movement restriction members **226** of the second strap **216**. At the same time, any given movement restriction member of a strap has an adjacent movement restriction member of the other strap disposed above or below, depending on which strap has been received into an upper opening of the other strap. In some embodiments, straps are disposed substantially parallel to each other when the straps would be aligned and adjacent to each other when drawn taut. In some embodiments, the first strap **116** and the second strap **216** are disposed in contact with each other.

In some embodiments, the straps **116**, **216** can be substantially parallel even when they include flexible material. For

example, the strap tie assembly **100** may undergo transient perturbations in configuration, orientation, shape, etc. during use; nevertheless, over time the straps **116**, **216** will remain substantially parallel as described above.

In some embodiments, the straps **116**, **216** are drawn taut once received by an opening in an opposing strap tie (e.g. strap ties **110**, **210**), because the distance between the first body **112** and the second body **212** corresponds to the lengths of the segments of the straps **116**, **216** that are disposed between the first body **112** and the second body **212** (e.g., in an inner/interior region of the strap tie assembly **100**).

In some embodiments, the first body **112** and the second body **212** are disposed on a region of skin (e.g. a region of skin including a first portion of skin, a wound, and a second portion of skin) that includes a curved profile. The first strap **116** and the second strap **216** may be substantially parallel by maintaining straight paths (e.g., paths of shortest distance) between the first body **112** and the second body **212** once received by the appropriate opening in an opposing strap tie. In some embodiments, substantially parallel includes a tolerance of a small difference in angle between the vectors defined by two components (e.g. less than 30 degrees, less than 20 degrees, less than 10 degrees, less than 5 degrees, less than 1 degree, etc.).

Referring now to FIG. 2 a perspective view of an embodiment of the strap tie assembly **100** is shown with the first base **114** and the second base **214** having extended base sections. In some embodiments, the first base **114** includes a first base extension **142** extending between a first proximal base end **138** and a first distal base end **140**. The first proximal base end **138** is disposed proximate to the first body **112** of the first strap tie **110**. The first base **114** may include a first base holder **144** protruding from a length of the first base extension **142**. The first base holder **144** includes a groove **146** configured to hold a first base attachment member **148**. The first base attachment member **148** may be similar in structure and function to the attachment member **134** shown in FIG. 1. A single first base attachment member **148**, or a plurality of first base attachment members **148**, may be provided to attach the first base extension **142** (and thus attach the first strap tie **110**) to a portion of skin, facilitating the application of an even amount of force across a wound when the strap tie assembly **100** is used to secure or close a wound. While FIG. 2 shows the first base attachment members **148** as staples, the first base attachment members **148** need not be provided as identical implements.

In some embodiments, similar to the first base **114**, the second base **214** includes a second base extension **242** extending between a second proximal base end **238** and a second distal base end **240**. The second proximal base end **238** is disposed proximate to the second body **212** of the second strap tie **210**. The second base **214** may include a second base holder **244** protruding from a length of the second base extension **242**. The second base holder **244** includes a groove (e.g., hole, cavity, recess, depression, etc.) such as a groove **246** configured to hold a second base attachment member **248**. The second base attachment member **248** may be similar in structure and function to the attachment member **234** shown in FIG. 1. A single second base attachment member **248**, or a plurality of second base attachment members **248**, may be provided to attach the second base extension **242** (and thus to attach the second strap tie **210**) to a portion of skin, facilitating the application of an even amount of force across a wound when the strap tie assembly **100** is used to secure or close a wound. While FIG. 2 shows the second base attachment members **248** as staples, the second base attachment members **248** need not be provided as identical imple-

ments. In various embodiments, the strap ties **110**, **210** may be secured to portions of skin at various distances from the wound, in order to apply a specific or selected tension (e.g., in order to apply an even amount of force across the wound).

As shown in FIG. 2, the first base extension **142** extends in a direction substantially parallel to the portion of the second strap **216** disposed between the first body **112** and the second distal end **230** of the second strap **216** (e.g., an outside portion of the second strap **216**) when the second strap **216** has been received by and passed through the first body **112**. The first base extension **142** similarly extends in a direction perpendicular to a plane defined by one or both of the faces of the openings **118**, **120**. The direction may be substantially parallel similar to a manner as described above for the orientation relationship between the first strap **116** and the second strap **216** when the straps **116**, **216** have been received by openings of an appropriate strap tie. In some embodiments, the direction is substantially parallel when the vectors corresponding to the angles at which the first base extension **142** extends from the first body **112** and the outside portion of the second strap **216** exits the first body **112** are substantially parallel.

The first base extension **142** extends in a direction substantially opposite to that of the first strap **116** (e.g., the first strap **116** extends from the first body **112** towards the second body **212** so that the second body **212** may receive the first strap **116**, whereas the first base extension **142** extends away from the second body **212**).

Similar to the first base extension **142**, the second base extension **242** extends in a direction generally parallel to the portion of the first strap **116** disposed between the second body **212** and the second distal end **130** of the first strap **116** (e.g., an outside portion of the first strap **116**) when the first strap **116** has been received by and passed through the second body **212**. The second base extension **242** similarly extends in a direction perpendicular to a plane defined by one or both of the faces of the second openings **218**, **220**. The second base extension **242** extends in a direction generally opposite the second strap **216** (e.g., the second strap **216** extends from the second body **212** towards the first body **112** so that the first body **112** may receive the second strap **216**, whereas the second base extension **242** extends away from the first body **112**).

Referring now to FIGS. 3-5, embodiments of the strap tie assembly **100** are shown in which the strap tie assembly **100** is disposed in a configuration in which the first strap tie **110** and the second strap tie **210** are drawn together more closely than in FIG. 2. That is, after the first strap **116** has been received and passed through the second upper opening **200** and the second strap **216** has been received and passed through the first lower opening **118**, the first strap **116** and the second strap **216** have been translated (e.g., pulled, drawn, etc.) further in opposite directions, tightening the strap tie assembly **100**. For example, a user may grasp the first strap **116** and the second strap **216** at the first handle **136** and the second handle **236**, respectively, and apply force to the first strap **116** and the second strap **216** in opposite directions (e.g., draw the first handle **136** away from the second body **212** and draw the second handle **236** away from the first body **112**, etc.).

In some embodiments, the first base **114** has been secured to a first portion of skin disposed on one side of a wound, and the second base **214** has been secured to a second portion of skin disposed on another side of a wound; drawing the first strap **116** and the second strap **216** apart (e.g., in opposite directions) results in the wound being drawn together to be closed, as the first portion of skin and the second portion of

11

skin are drawn together due to force applied to the first base **114** and the second base **214** via the first strap **116** and the second strap **216**.

In some embodiments, the interaction between the engagement members of the strap ties **110**, **210** (e.g., engagement members **122**, **124**, **222**, **224** shown in FIG. 1, etc.) and the movement restriction members of the strap ties **110**, **210** (e.g., movement restriction members **126**, **226**, etc.) allows a user to adjust the position of the strap ties **110**, **210** relative to the bodies **112**, **212** in specific and/or discrete amounts. For example, in some embodiments, a user may count or otherwise keep track of the distance a strap has been drawn through a body of a remote strap tie (e.g., strap **116** and body **212** of remote strap tie **210**, etc.) based on the number movement restriction members **126**, **226** that have been passed through the bodies **212**, **112**, respectively.

In some embodiments, the movement restriction members **126** and/or the movement restriction members **226** are spaced in a specific pattern, allowing the manipulation of the strap ties **110**, **210**, and thus the force applied across a wound, to be controlled and adjusted in a specific manner. For example, in some embodiments, the movement restriction members proximate to a body (e.g., the first movement restriction members **126** of first strap **116** proximate to the first body **112** of the first strap tie **110**, etc.) may be spaced apart by relatively large amounts, allowing for the strap to be translated in relatively large amounts through a remote body, while the movement restriction members distal from the body may be spaced apart by relatively small amounts, allowing for the strap to be translated in relatively small amounts through the remote body. In some embodiments, the movement restriction members are spaced apart equally.

Referring now to FIG. 6, a detailed perspective view of an embodiment of a strap tie **110** is shown. The strap tie **110** includes a body **112**, a base **114** configured to be disposed adjacent to a portion of skin, and a strap extending from the body **112**. The strap tie **110** also includes an upper opening **120** and a lower opening **118**. Each of the openings **118**, **120** are configured to receive a strap from a remote strap tie (e.g., strap tie **210**, etc.). The strap tie **110** also includes an upper engagement member **124** disposed within the upper opening **120**, and a lower engagement member **122** disposed within the lower opening **118**. As shown in FIG. 6, the engagement members **122**, **124** are disposed in opposing directions; the upper engagement member **124** and the lower engagement member **122** each curve towards a central face **150** disposed between the upper opening **120** and the lower opening **118**. As such, each of the openings **118**, **120** may receive a strap (e.g., second strap **216** shown in FIGS. 1-5, etc.), between the central face **150** and the respective engagement member **122**, **124**.

As shown in FIG. 6, the upper engagement member **124** and the lower engagement member **122** are each provided as a pawl. For example, the lower engagement member includes a recess **160** defined by a vertical edge **162** and an angled edge **164**. When a movement restriction member of a remote strap tie (e.g., movement restriction member **226** shown in FIG. 1, etc.) engages the lower engagement member **122**, the movement restriction member **226** fits into (e.g., is received by, engages, removably couples to, etc.) the recess **160**. The engagement between the lower engagement member **122** and the movement restriction member **226** allows translation of the strap associated with the movement restriction member **226** (e.g., strap **216** shown in FIG. 1, etc.) in one direction, when the movement restriction member **226** slides along the angled edge **164**, while preventing translation of the movement restriction member **226** in another direction (e.g., an

12

opposite direction), when the movement restriction member **226** abuts the vertical edge **162**.

In some embodiments, the movement restriction members **126** are disposed at an angle, facilitating an engagement with the engagement member **122** in which the remote strap (e.g., strap **216** shown in FIG. 1, etc.) is prevented from being translated away from the body **112**. In some embodiments, the movement restriction members **126** are provided on multiple outer surfaces of the strap **116**, such as an upper surface **132** and a lower surface **133**. For example, the movement restriction members **126** may originate in pairs from a central body of the strap **116**. The movement restriction members **126** may be provided as single movement restriction members that pass through from the upper surface **132** to the lower surface **133**. As such, both the upper surface **132** and the lower surface **133** of the strap **116** may be engaged by an engagement member of a remote strap (e.g., engagement member **222** shown in FIG. 1, etc.). This underscores the modularity of the strap tie assembly **100**, as the strap ties **110**, **210** may be interchangeably manipulated and engaged. Such modular features facilitate using the strap tie assembly **100** in situations when the strap tie assembly **100** is to be quickly implemented, including but not limited to trauma or battlefield situations.

Referring now to FIG. 7, a detailed perspective view of an embodiment of the strap tie **110** (e.g., a first strap tie **110**, etc.) receiving a remote strap **216** (e.g., a second strap **216** as shown in FIG. 1, etc.) is shown. The remote strap **216** has been received through upper opening **120** and engaged by engagement member **124**. In various embodiments, the remote strap **216** may also be received through lower opening **118** and engaged by engagement member **122**.

Referring further to FIGS. 6-7, the attachment member **134** is shown as contrasted between a pre-secured state and a secured state. As shown in FIG. 6, the attachment member includes two attachment arms **135a**, **135b**. As shown in FIG. 7, the attachment arms **135a**, **135b** have been translated/shifted, such as in order to attach the attachment member **134** to a portion of skin. For example, as shown in FIGS. 6-7, the attachment member **134** is a staple, which may be attached to a portion of skin using a tool such as a staple gun, etc.

Referring now to FIGS. 8-9, a strap tie assembly **300** is shown. The strap tie assembly **300** is similar in function to the strap tie assembly **100** shown in FIGS. 1-7. FIG. 8 shows a perspective view of an embodiment of the strap tie assembly **300**. FIG. 9 shows a detailed perspective view of an embodiment of the strap tie assembly **300**. The strap tie assembly **300** includes a first strap tie **310** and a second strap tie **410**. The first strap tie **310** includes a first body **312**, a first strap **316** attached to and/or extending from the first body **312**, and a first base **314** attached to and/or extending from the first body **312**. The first body **312** includes a first left opening **318** and a first right opening **320** disposed proximate to the first proximal end **328** of the first strap **316**. Similarly, the second strap tie **410** includes a second body **412**, a second strap **416** attached to and/or extending from the second body **412**, and a second base **414** attached to and/or extending from the second body **412**. The second body **412** includes a second left opening **418** and a second right opening **420** disposed proximate to the second proximal end **428** of the second strap **416**. Such a configuration of openings in the first body **312** and the second body **412** may be referred to as "side-by-side," based on the positions of the openings relative to each other and the respective bases **314**, **414** of the bodies **312**, **412** (in comparison, the openings **118**, **120** and **218**, **220** as shown in FIGS. 1-7 may be considered to have upper/lower positions relative to each other and the respective bases **114**, **214** of the bodies **112**,

13

212). In some embodiments, a plane passing through the openings of a body (e.g., first left opening 318 and first right opening 320 of first body 312; second left opening 418 and second right opening 320 of second body 412, etc.) is perpendicular to a longitudinal axis defined by a strap (e.g., strap 316, strap 416, etc.) and/or parallel to a transverse axis passing through both the first strap 316 and the second strap 416 when the first strap 316 and the second strap 416 have been received by an opposite (e.g., complementary, etc.) strap tie. The first strap 316 includes first movement restriction members 326, and the second strap 416 includes second movement restriction members 426.

The first body 312 may include an engagement member disposed in each of the first left opening 318 and the first right opening 320, such as an engagement member 324. The second body 412 may include an engagement member disposed in each of the second left opening 418 and the second right opening 420. Engagement members of the strap tie assembly 300, such as the engagement member 324, are similar in structure and function to the engagement members of the strap tie assembly 100.

As shown in FIG. 8, the first strap 316 includes a first loop handle 360 disposed at a distal end 330 of the first strap 316. The first loop handle 360 includes loops 364, 366 disposed between the distal end 330 of the first strap 316 and a distal end 368 of the first loop handle 360. Similar to the first loop handle 360, the second loop handle 460 includes loops 464, 466 disposed between the distal end 430 of the second strap 416 and a distal end 468 of the second loop handle 460. The first loop handle 360 and the second loop handle 460 facilitate manipulation of the straps 316, 416, for example, by providing handles to a user which are easy to grip and manipulate. While FIG. 8 shows the loop handles 360, 460 disposed in a plane generally containing the straps 316, 416, in various embodiments, the loop handles 360, 460 may be disposed in various orientations. In some embodiments, the strap tie assembly 300 includes flexible or malleable material (e.g., material that may yield or be rotated, etc.), allowing the loop handles 360, 460 to be manipulated at various angles. The loop handles 360, 460 may include material allowing the loop handles 360, 460 to be reduced in size (e.g., compressed, squeezed, etc.) so that the loop handles 360, 460 may be passed through an opening of a strap tie.

Referring now to FIGS. 10-11, a strap tie assembly 500 is shown. The strap tie assembly 500 is similar in structure and function to the strap tie assembly 300 shown in FIGS. 8-9. FIG. 10 is a perspective view of the strap tie assembly 500. The strap tie assembly 500 includes a first strap tie 510 and a second strap tie 610. As shown in FIG. 10, the strap tie assembly 500 includes a first loop handle 560 attached to a first strap 516, and a second loop handle 660 attached to a second strap 616.

FIG. 11 is a top view of an embodiment of the strap tie assembly 500. The first strap tie 510 includes a first inner body 512, a first outer body 513, a first strap 516 attached to and/or extending from the first inner body 512, and a first base 514. Similar to the first strap tie 510, the second strap tie 610 includes a second inner body 612, a second outer body 613, a second strap 616 attached to and/or extending from the second inner body 612, and a second base 614. The inner bodies 512, 612 are disposed on an "interior" of the strap tie assembly 500 (e.g., the region of the strap tie assembly 500 between the inner bodies 512, 612 is an interior or inner region, in which the straps 516, 616 overlap when the first strap tie 510 engages the second strap tie 610, while the regions outside of

14

the outer bodies 513, 613 are exteriors or outer regions). The outer bodies 513, 613 are disposed distal from the interior of the strap tie assembly 500.

In some embodiments, the first inner body 512 includes a first inner opening 518 for receiving the second strap 616, and the first outer body 513 includes a first outer opening 520 for receiving the second strap 616 once the second strap 616 has been received through the first inner opening 518. Similarly, the second inner body 612 includes a second inner opening 618 for receiving the first strap 516, and the second outer body 613 includes a second outer opening 620 for receiving the first strap 516 once the first strap 516 has been received through the second inner opening 618. As such, each strap tie may include a pair bodies. As shown in FIG. 11, the first outer body 513 is attached to the first inner body 512 proximate to the first proximal end 528 of the first strap 516; similarly, the second outer body 613 is attached to the second inner body 612 proximate to the second proximal end 628 of the second strap 616. As shown in FIG. 11, the inner openings 518, 618 have a depth (e.g., the length of a strap that passes through the opening) that is greater than the depth of the outer openings 520, 620. In various embodiments, various modifications may be made to the sizes of the openings (e.g., the depth of the outer openings 520, 620 may be greater than the depth of the inner openings 518, 618).

In some embodiments, the first inner body 512 and the second inner body 612 are provided as movable elements that allow for disengagement (e.g., loosening, decoupling, separating) of the first strap tie 510 from the second strap 616, and/or for disengagement of the second strap tie 610 from the first strap 516. For example, the inner bodies 512, 612 may include an engagement member (e.g., an engagement member similar to the engagement members provided for strap tie assemblies 100, 300), and the inner bodies 512, 612 may be provided as a button or other actuator such that actuation (e.g., squeezing, pushing, sliding, etc.) of the inner bodies 512, 612 disengages the engagement members from a corresponding movement restriction member (e.g. movement restriction members 526, 626). In some embodiments, the engagement members are flexible, such that they respond to actuation by the inner bodies 512, 612 by deforming or otherwise changing in shape, and thus may be disengaged from the movement restriction members 526, 626.

In some embodiments, the straps 516, 616 are oriented at an angle (e.g., a 90-degree angle, etc.) relative to the bases 514, 614. For example, as shown in FIGS. 10-11, when the first strap tie 510 and the second strap tie 610 are engaged, a transverse axis that passes through the straps 516, 616 in the interior region of the strap tie assembly 500 is parallel to a plane generally containing the bases 514, 614. In other words, when the strap tie assembly 500 is assembled (e.g., the first strap tie 510 and the second strap tie 610 are engaged) and secured to portions of skin on either side of a wound, the movement restrictions members 526, 626 of each strap 516, 616 will both tend to face in a direction that does not intersect with the portions of skin or the wound.

Referring now to FIGS. 12-15, a strap tie assembly 700 is shown. The strap tie assembly is similar in structure and function to the strap tie assembly 500 shown in FIGS. 10-11. FIG. 12 is a perspective view of the strap tie assembly 700. The strap tie assembly includes a first strap tie 710 and a second strap tie 810. The first strap tie 710 includes a first body 712 that includes a single opening for receiving a second strap 816 of the second strap tie 810. Similarly, the second strap tie 810 includes a second body 812 that includes a single opening 818 for receiving a first strap 716 of the first strap tie 710. When the straps 716, 816 have been received by corre-

15

sponding openings, the straps **716**, **816** are disposed adjacent to and parallel to each other. A first base **714** extends from the first body **712**, and similarly a second base **814** extends from the second body **812**.

FIG. **13** shows a detail perspective view of a distal end **830** of the second strap **816**. The distal end **830** has been provided with a second handle **860**. As shown in FIG. **13**, the second handle **860** is detachably coupled to a second strap handle **836** disposed at the distal end **830** of the second strap **816**. The second handle **860** includes a second handle body **862** defining a second handle opening **864**. The second handle opening **864** is configured to receive (e.g., detachably couple to, have inserted, engage) the second strap handle **836**. In other words, the second handle **860** may be provided as a modular device to supplement the grip/handling provided by the second strap handle **836** of the second strap **816**. The second handle **860** also includes a pair of handle lobes **866**, **868** extending from an opposite end of the second handle body **862** from where the second handle opening **864** receives the second strap **816**. In some embodiments, the handle lobes **866**, **868** include lobe openings **870**, **872**, which may allow a user to further grip/handle the second handle **860** (e.g., to insert a finger through the lobe openings **870**, **872**, etc.). Referring back to FIG. **12**, the distal end **730** of the first strap **716** may also be provided with a first handle **760** proximate to a first strap handle **736** of the first strap **716**. The first handle **760** may be similar to or identical to the second handle **860**. For example, the first handle **760** and the second handle **860** may be identical and interchangeable. As shown in FIG. **12**, the first handle **760** includes a first handle body **762** for receiving the first strap **716** in a first handle opening **764**, and a pair of first handle lobes **766**, **768** extending from an opposite end of the first handle body **762** from where the first handle body **762** receives the first strap.

Referring further to FIGS. **14-15**, detail views of the first strap tie **710** and the second strap tie **810** are shown in order to illustrate the operation of the engagement mechanism between the strap bodies **712**, **812** and the straps **716**, **816**. The first strap tie **710** includes a first engagement member **722**. The first strap tie **710** also includes a first engagement base **724** extending from the first body **712**. The first engagement base is disposed on an inward side of the first strap tie **710** (e.g., adjacent to the proximal end **728** of the first strap **716**; etc.). The first engagement base **724** also includes an opening for receiving a strap from another strap tie. The first engagement member **722** includes a first engagement portion **742** for engaging a second movement restriction member **826** of the second strap **816**, and a first actuator **740**. The first actuator **740** may be manipulated (e.g., squeezed, translated, pushed, adjusted, etc.) in order to engage or disengage the first engagement portion **742** from the second movement restriction member **826**. For example, as shown in FIGS. **14-15**, the first actuator **740** may be squeezed towards the first engagement base **724** (e.g., substantially parallel to the direction that the second strap **816** passes through the opening of the first strap tie **710**), in order to disengage the first engagement portion **742** from the second movement restriction member **826**.

The second strap tie **810** may include a similar or identical engagement mechanism as provided for the first strap tie **710**. For example, as shown in FIGS. **12**, **14**, and **15**, the second strap tie **810** receives the first strap **716** through a second opening **818** of a second engagement base **824**. A second engagement member **822** is configured to engage a first movement restriction member **726** of the first strap **716**. A second actuator **840** may be manipulated in order to engage or disengage the second

16

engagement portion **842** from the first movement restriction member **726**. The second engagement base **824** is disposed on an inward side of the second strap tie **810**, such that the second opening **818** is disposed adjacent to the proximal end **828** of the second strap **816**. The second engagement base **824** is provided continuous with a plane defined by the second opening **818**, perpendicular to the direction through which the first strap **716** is received through the second opening **818**. As such, when each strap tie **710**, **810** has received a strap **716**, **816** from the other strap tie, the straps **716**, **816** are disposed adjacent and parallel to each other.

Referring now to FIGS. **16-19**, a strap tie assembly **900** is shown. The strap tie assembly **900** is similar in structure and function to the strap tie assembly **700** shown in FIGS. **12-15**. The engagement mechanism of the strap tie assembly **900** is similar to the engagement mechanism of the strap tie assembly **700**. A first strap tie **910** includes a first strap body **912**. The first strap body **912** includes a first engagement member **922** that can engage/disengage a second movement restriction member **1026** of a second strap **1016** of the second strap tie **1010**, for example by squeezing the first engagement mechanism **922** towards a first engagement body **924**. The first strap body **912** includes a first opening **918** disposed adjacent to a proximal end **928** of the first strap **916**. The first engagement member **922** is disposed above (e.g., on an opposite side of the first strap body **912** from a first base **914** of the first strap body **912**) the first opening **918**, and can be actuated (e.g., squeezed) in a direction perpendicular to a direction that a second strap **1016** may be received through the first opening **918**.

The second strap tie **1010** may be similar or identical to the first strap tie **910**. As shown in FIGS. **16** and **19**, the second strap tie **1010** includes a second strap body **1012**. The second strap body **1012** includes a second engagement member **1022** that can engage/disengage a first movement restriction member **926** of the first strap **916**, for example by squeezing the second engagement member **1022** towards a second engagement body **1024**. The second strap body **1012** includes a second opening **1018** disposed adjacent to a proximal end **1028** of the second strap **1016**. The second engagement member **1022** is disposed above (e.g., on an opposite side of the second strap body **1012** from a second base **1014** of the second strap body **1012**) the second opening **1018**, and can be actuated (e.g., squeezed) in a direction perpendicular to a direction that the first strap **916** may be received through the second opening **1018**.

Referring further to FIGS. **16-19**, the strap ties **910**, **1010** include handles **936**, **1036** extending from respective distal ends **930**, **1030** of the strap ties **910**, **1010**. The handles **936**, **1036** are provided with handle protrusions **938**, **1038**, to facilitate gripping of the handles **936**, **1036** by a user. The handles **936**, **1036** curve away from the bases **914**, **1014** of the respective strap ties **910**, **1010**. Protrusions such as handle protrusions **938**, **1038** provide indentations in between the handle protrusions **938**, **1038**.

Referring further to FIG. **17**, a side detail view of the strap tie assembly **900** in the region of the second strap body **1012** is shown to illustrate particular features of the engagement mechanism and the handle **936**. An upper surface **932** (e.g., a surface which is disposed on an opposite side of the first strap **916** from a portion of skin/a wound; a surface which is disposed on an opposite side of the first strap **916** from the second base **1014**, etc.) of the first strap **916** includes first edge cavities **925**. As shown in FIG. **17**, the first edge cavities **925** include a biased shape, such that the first edge cavities **925** include a greater gradient towards the distal end **930** of the first strap **916**. The first edge cavities **925** may act in a

17

similar manner to an engagement mechanism such as an engagement member, in order to selectively or consistently prevent translation of the first strap tie **910** away from the second strap tie **1010**. When the first edge cavities **925** include a biased shape, the first edge cavities **925** may be configured to engage a pawl in order to prevent translation of the first strap tie **910** away from the second strap tie **1010**. In some embodiments, the first edge cavities **925** provide resistance to slipping, such as slipping that might occur between the first strap **916** and the hand(s) of a user when gripping the first strap **916**, such as when the first strap **916** is covered in blood, lipids, or other fluids. As shown in FIG. 19, the second strap **1016** may also include an upper surface **1032** including second edge cavities **1025**, which may be similar to or identical to the first edge cavities **925**. For example, the second edge cavities **1025** may also include a biased shape, such that when each of the straps **916**, **1016** have been received by an opposing strap tie **1010**, **910**, the straps **916** are aligned parallel to and adjacent to one another, and the first edge cavities **925** and second edge cavities **1025** have an opposing orientation.

Referring back to FIG. 17, the first strap **916** may also include a lower surface **933** (e.g., a surface which is disposed on a side of the first strap **916** proximate to a portion of skin/a wound; a surface which is disposed on a side of the first strap proximate to the second base **1014**; etc.), and the lower surface **933** may include first protrusions **927**.

Referring now to FIG. 18, a perspective view is shown of a bottom or lower side of the strap tie assembly **900** (e.g., the side of the strap tie assembly **900** to be disposed proximate to a portion of skin/a wound, etc.). FIG. 18 illustrates the first protrusions **927** disposed along the lower surface **933** of the first strap **916**, and the second protrusions **1027** disposed along the lower surface **1033** of the second strap **1016**. The second protrusions **1027** may be similar or identical to the first protrusions **927**. For example, as shown in FIG. 18, the protrusions **927**, **1027** have similar spacing along the respective lower surfaces **933**, **1033**, and include similar shapes provided by two equal and opposite angled edges. In various embodiments, the protrusions **927**, **1027** may include various shapes, such as shapes biased towards one side, rectangular solids, trapezoidal solids, curved or elongated solids, etc. As shown in FIGS. 17 and 18, the protrusions **927**, **1027** extend a distance away from respective surfaces **933**, **1033** such that the protrusions **927**, **1027** will not contact a wound or a portion of skin when at least one of the bases **914**, **1014** contacts a wound or a portion of skin. In some embodiments, the protrusions **927**, **1027** extend a distance away from respective surfaces **933**, **1033** such that the protrusions **927**, **1027** are configured to engage openings with the corresponding opposing strap bodies **1012**, **912**. In some embodiments, the protrusions **927**, **1027** provide resistance to slipping, such as slipping that may occur between straps **916**, **1016** and the hand(s) of a user when gripping the straps **916**, **1016**, such as when the straps **916**, **1016** are covered in blood, lipids, or other fluids.

Referring further to FIG. 19, a detail perspective view of the strap tie assembly **900** proximate to the second strap tie **1010** is shown to illustrate features of the engagement mechanisms of the strap tie assembly **900**. The second strap **1016** includes the second movement restriction members **1026** and the second edge cavities **1025** as being biased towards the “right” based on the orientation shown (e.g., the second strap **1016** extends in a first direction away from the second strap body **1012**, and the second movement restriction members **1026** are biased in a second direction opposite to the first direction). Similarly, because the first strap **916** is disposed parallel and adjacent to the second strap **1016** while extending

18

in an opposite direction as the second strap **1016** (e.g., extending from the first strap body **910** shown in FIG. 16, etc.), the first movement restriction members **926** and the first edge cavities **925** are biased towards the “left” based on the orientation shown. The biased orientation (e.g., disposed at an angle relative to a plane defined by a respective strap **916**, **1016**, etc.) of the movement restriction members **926**, **1026** facilitates preventing translation of a strap away from an engagement member. For example, when the first strap **916** has been received through the second opening **1018**, the engagement between the second engagement member **1022** and the first movement restriction members **926** allows the first strap **916** to be drawn towards the “right” so that a distance between the second strap tie **1010** and a first strap tie (e.g., first strap tie **910** shown in FIG. 16, etc.) decreases, while preventing translation of the first strap **916** in a manner in which a distance between the second strap tie **1010** and the first strap tie **910** would increase. This one-directional engagement and translation mechanism may also apply to the interaction between the second strap **1016** and the first strap tie **910**, and between the edge cavities **925**, **1025** and corresponding opposing strap ties **1010**, **910**.

As shown in FIG. 19, the second engagement member **1022** may be manipulated (e.g., adjusted, pushed, squeezed, etc.) by being translated towards the second engagement base **1024**. When the second engagement member **1022** is manipulated, the second engagement member **1022** no longer engages a first movement restriction member **926** of the first strap **916**, such that the first strap **916** may be translated both in a first direction “towards” the second strap tie **1010** such that a distance between the first strap tie **910** and the second strap tie **1010** decreases, and a second direction “away” from the second strap tie **1010** such that a distance between the first strap tie **910** and the second strap tie **1010** increases. In some embodiments, the biasing of the edge cavities **925**, **1025** is great enough to aid in preventing translation of the strap ties **910**, **1010** away from each other, but such biasing is not sufficient to independently prevent translation of the strap ties **910**, **1010** away from each other when one or both of the engagement members **922**, **1022** have been disengaged from corresponding movement restriction members **1026**, **926**. In some embodiments, the edge cavities **925**, **1025** provide resistance to slipping, such as slipping that may occur between the straps **916**, **1016** and the hand(s) of a user when gripping the straps **916**, **1016**, such as when the straps **916**, **1016** are covered in blood, lipids, or other fluids.

Referring now to FIGS. 20-22, a strap tie assembly **1100** is shown. The strap tie assembly **1100** is similar in structure and function to the strap tie assembly **900**. FIG. 20 is a perspective view of the strap tie assembly **1100**. The strap tie assembly **1100** includes a first strap tie **1110** and a second strap tie **1210**. The first strap tie **1110** includes a first strap body **1112**, a first base **1114** extending from the first strap body **1112**, a first strap **1116** extending from the first strap body **1112**, and an engagement mechanism for engaging a strap from another strap tie including a first engagement member **1122** and a first engagement base **1124**. First movement restriction members **1126** are provided along the first strap **1116**. Similarly, the second strap tie **1210** includes a second strap body **1212**, a second base **1214** extending from the second strap body **1212**, a second strap **1216** extending from the second strap body **1212**, and an engagement mechanism for engaging a strap from another strap tie including a second engagement member **1222** and a second engagement base **1224**. Each of the straps **1116**, **1216** includes respective movement restriction members **1126**, **1226**.

19

Referring further to FIG. 21, a detail perspective view of the second strap tie 1210 is shown to illustrate the engagement mechanism of the second strap tie 1210, such as when a first strap 1116 is received in a second opening 1218 of the second strap tie 1210. The second engagement member 1222 is similar to the second engagement member 1022 shown in FIGS. 16-19, and the second engagement base 1224 is similar to the second engagement base 1024 shown in FIGS. 16-19. The second engagement member 1222 and the second engagement base 1224 each extend a further distance away (e.g., in a direction away from where the strap tie assembly 1100 would be disposed along a portion of skin or along a wound) from the second strap body 1212 than the similar second engagement member 1022 and second engagement base 1024.

Referring further to FIG. 22, a detail perspective view is shown of a bottom or lower side of the strap tie assembly 1100 (e.g., a side of the strap tie assembly 1100 proximate to where the second base 1214 may be disposed adjacent to a portion of skin or a wound, etc.) in the vicinity of the second strap body 1212. The first strap 1116 includes protrusions 1127 disposed along a lower surface 1133 of the first strap 1116. As compared to the protrusions 927 of the first strap 916 shown in FIGS. 16-19, the protrusions 1127 of the first strap 1116 are provided only along a distal region of the lower surface 1133 (e.g., a region of the lower surface 1133 running only partially from the distal end 1130 towards a proximal end 1128 as shown in FIG. 20). For example, as shown in FIG. 22, the region of the lower surface 1233 of the second strap 1216 (which may be similar or identical to the first strap 1116) that is proximate to the proximal end 1228 does not include protrusions. As such, protrusions may be selectively provided such that they would not be disposed directly above a wound when the strap tie assembly 1100 is attached to portions of skin adjacent to the wound. In various embodiments, various numbers and groupings of protrusions may be provided along lower surfaces of straps of the strap tie assembly 1100 based on whether the protrusions would be disposed above a wound, how tightly the strap tie assembly 1100 is expected to be drawn together, how often the strap tie assembly 1100 is expected to be adjusted, etc. As shown in FIG. 22, the protrusions 1127 are biased towards the "left" based on the orientation shown in the figure (e.g., the protrusions 1127 extend further away from the lower surface 1133 on a side of the protrusions 1127 that is closer to the proximal end 1128 than the distal end 1130, etc.). Providing the protrusions 1127 with a such a bias may facilitate manipulation of the strap tie assembly 1100 in which the engagement between the second strap tie 1210 and the first strap 1116 prevents translation of the first strap tie (see, e.g., first strap tie 1110 shown in FIG. 20) away from the second strap tie 1210. In various embodiments, various biases may be provided to protrusions such as the protrusions 1127 in order to select the resistance that the protrusions 1127 provide against translation of the first strap 1116 in a certain direction.

Referring now to FIGS. 23-26, a strap tie assembly 1300 is shown. The strap tie assembly 1300 is similar in structure and function to the strap tie assembly 1100 shown in FIGS. 20-22. FIG. 23 is a perspective view of the strap tie assembly 1300. The strap tie assembly includes a first strap tie 1310 and a second strap tie 1410. FIGS. 24-26 are detailed side, bottom, and end perspective views of the strap tie assembly 1300 in the vicinity of the second strap tie 1410, illustrating features of the engagement mechanism and the straps of the strap tie assembly 1300. The first strap tie 1310 includes a first strap body 1312, with a first strap 1316 extending from the first strap body 1312. A first base 1314 extends from the first body.

20

The first strap tie 1310 includes a first engagement member 1322 and a first engagement base 1324 that are similar to the first engagement member 922 and the first engagement base 924 shown in FIGS. 16-19, with wider profiles (e.g., a length of the first engagement member 1322 along an axis parallel to the first strap 1316 is greater than a similar length of the first engagement member 922; a length of the first engagement base 1324 along an axis parallel to the first strap 1316 is greater than a similar length of the first engagement base 924; etc.). Similarly, the second strap tie 1410 includes a second strap body 1412, and a second engagement member 1422 and a second engagement base 1424 that are similar to the second engagement member 1022 and the second engagement base 1024 shown in FIGS. 16-19, with wider profiles. The second engagement member 1422 may be similar or identical to the first engagement member 1322; the second engagement base 1424 may be similar or identical to the first engagement base 1324. A second strap 1416, which is similar to the first strap 1316, extends from a second proximal end 1428 adjacent to the second strap body 1412 to a second distal end 1430, with second movement restriction members 1426 disposed along the second strap 1416.

Referring further to FIG. 24, the first strap 1316 may terminate in a first handle region 1336 that extends towards a distal end 1330 of the first strap 1316. The first handle region 1336 is provided at an angle relative to the rest of the first strap 1316. As shown in FIGS. 23-26, when the strap tie assembly 1300 has been assembled, the first handle region 1336 extends at an angle away from the second base 1414. The first handle region 1336 includes protrusions 1338. The protrusions 1338 may be similar or identical to other protrusions disclosed herein (e.g., protrusions 927 shown in FIG. 18; protrusions 1127 shown in FIG. 23, etc.). In some embodiments, the first handle region 1336 is relatively elongated as compared to the first strap 1316 (e.g., a length of the first handle region 1336 may be greater than one half the length of the first strap 1316, greater than one quarter the length of the first strap 1316, greater than one eighth the length of the first strap 1316, etc.). The second strap 1416 may also terminate in a second handle region 1436 that is similar or identical to the first handle region 1336. As shown in FIG. 23, the second strap 1416 may include protrusions 1438 that are similar or identical to other protrusions disclosed herein.

Referring further to FIG. 25, a lower surface 1340 of the first handle region 1336 (e.g., a surface disposed proximate to the second base 1414 when the first strap 1316 has been received by the second strap tie 1410) includes protrusions 1339. The protrusions 1339 may be similar or identical to the protrusions 1338. As shown in FIGS. 24-25, the protrusions 1338, 1339 are biased, facilitating manipulation of the strap tie assembly 1300 in which the engagement between the first strap 1316 and the second strap tie 1410 prevents translation of the first strap tie 1310 away from the second strap tie 1410. The second strap 1416 may also be provided with lower surface protrusions that are similar or identical to the protrusions 1339.

Referring further to FIG. 26, the second strap tie 1410 is configured to engage the first strap 1316 using a second engagement member 1422. The second engagement member 1422 includes a second engagement unit 1423 that may be disposed within a second opening 1418 of the second strap tie 1410. When the second strap tie 1410 receives the first strap 1316 through the second opening 1418, the second engagement unit 1423 engages a first movement restriction member 1326 of the first strap tie 1316. The first strap 1316 includes a first ramp region 1320 between the first movement restriction members 1326 and the first handle region 1336. The first ramp

region **1320** may facilitate translation of the first strap **1316** through the second opening **1418**, by providing a thickness gradient between the relatively thin first handle region **1336** and the relatively thick region of the first strap **1316** that includes the first movement restriction members **1326**. The second strap **1416** may be similar or identical to the first strap **1316**.

In various embodiments, multiple strap tie assemblies (e.g., strap tie assemblies **100**, **300**, **500**, **700**, **900**, **1100**, **1300**) may be used to secure and/or close a wound, such as in a strap tie grouping. For example, a first strap tie assembly **100** may be disposed across a first region of a wound in order to secure the first region of the wound, and a second strap tie assembly **300** may be disposed across a second region of a wound in order to secure the second region of the wound. The wound regions may have similar properties (e.g., cross-wound distance, healing status, etc.) and the strap tie assemblies may be drawn to similar tightness in order to apply an even amount of force across the wound. The wound regions may have different properties and the strap tie assemblies may be drawn to different tightnesses in order to apply an even amount of force across the wound. Various numbers and lengths of strap ties and strap tie assemblies may be used to secure and/or close the wound (e.g., depending on the location of the body where the wound has occurred; the curvature of the skin; the sensitivity of regions near the wound such as organs, joints, facial structures; etc.). In some embodiments, a strap tie grouping includes multiple strap ties for each side of a wound joined together. The multiple strap ties may be joined together with a tie, a line, a thread, a strip, etc. The multiple strap ties may be joined together with a strip of adhesive, such that the multiple strap ties may be held in place together and also attached to a portion of skin. In some embodiments, a strap tie grouping includes between two and five strap ties for each side of a wound.

Referring now to FIGS. **27-30**, multiple strap tie assemblies **1300** are provided together as a strap tie grouping **1500**. The strap tie grouping **1500** is disposed across a wound **10**, with a set of first strap ties **1310** disposed on a first portion of skin **12**, and a set of second strap ties **1410** disposed on a second portion of skin **14**. The strap tie grouping **1500** may be attached to the skin in any manner as described herein. As shown in FIGS. **27-30**, the strap tie assemblies **1300** have been adjusted to different tightnesses (e.g., the distance between the first strap body **1312** and the second body **1412**), such that the wound tapers from a relatively thin portion at the outer edges **16**, **18** to a relatively thick portion in the center **20**. In various embodiments, various qualities of the wound may be used to determine how tightly each strap tie assembly **1300** is adjusted in order to variously tighten portions of skin across the wound.

Referring now to FIG. **31**, a block diagram of an embodiment of a method **1600** of securing a wound using a strap tie system is shown. The method may be implemented using any of the strap tie assemblies and devices disclosed herein, such as strap tie assemblies **100**, **300**, **500**. A variety of users may perform the method, including but not limited to an individual having a wound, a medical care professional (e.g., doctor, nurse, etc.), a patient, a trauma care provider, a field care provider, a civilian, a soldier, etc.

At **1610**, a first strap tie is secured adjacent to a first portion of skin on a first side of a wound, and a second strap tie is secured adjacent to a second portion of skin on a second side of a wound. The strap ties may be secured in any manner as disclosed herein (e.g., detachably secured, attached, removably coupled, etc.). The strap ties may be secured using attachment members (e.g., staples, hooks, adhesives, etc.). In

various embodiments, the strap ties are secured to the portions of skin at various distances from the wound (e.g., a selected distance from the wound), in order to apply a specific amount of force and/or tension across the wound (e.g., an even amount of force across the wound). In some embodiments, a user can secure the first strap tie adjacent to the first portion of skin on the first side of the wound, and a user can secure the second strap tie adjacent to the second portion of skin on the second side of the wound. In some embodiments, a user can select the distance from the wound that at least one of the first strap tie and the second strap tie is secured to a respective portion of skin.

At **1620**, each strap tie receives a strap from the other strap tie. For example, the first strap tie receives a second strap from the second strap tie, through a first opening in a first body of the first strap tie, and the second strap tie receives a first strap from the first strap tie, through a second opening in a second body of the second strap tie. In some embodiments, a user can receive the second strap from the second strap tie through the first opening in the first body of the first strap tie by drawing (e.g., pulling, threading, pushing, etc.) the second strap through the first opening. Similarly, a user can receive the first strap from the first strap tie through the second opening in the second body of the second strap tie by drawing the second strap through the second opening. In some embodiments, the strap ties are already assembled as a strap tie assembly, so that a user (e.g., a medic, a surgeon, a technician, etc.) can tighten the straps (see **1630**) immediately after securing the strap tie assembly.

At **1630**, candidate movement restriction members are selected for engaging with engagement members of each tie strap. For example, a first candidate movement restriction member disposed along a surface of the first strap is selected, in order to be engaged by a second engagement member of the second strap tie. Similarly, a second candidate movement restriction member disposed along a surface of the second strap is selected, in order to be engaged by a first engagement member of the first strap tie. The candidate restriction members may be selected in order to apply an even amount of force across the wound. The candidate restriction members may be selected in order to draw each strap a certain distance through an opening of the other strap. The candidate restriction members may be selected based on an effect on the portions of skin or on the wound, such as a distance between the portions of skin as the wound is closed, etc. In some embodiments, a user can select the first candidate restriction member for the first strap, and a user can select the second candidate restriction member for the second strap.

At **1640**, the engagement members are engaged to the respective candidate movement restriction members. For example, the first engagement member of the first strap tie is engaged to the second candidate movement restriction member, and the second engagement member of the second strap tie is engaged to the first candidate movement restriction member. Engagement members and movement restriction members may be engaged by drawing the straps a certain distance through respective openings of the strap ties until the engagement members are aligned with/engage the appropriate movement restriction member. A user can engage the first engagement member to the second candidate movement restriction member by aligning the first engagement member with the second candidate movement restriction member and engaging, joining, attaching, or otherwise coupling the first engagement member and the second candidate movement restriction member. A user can engage the second engagement member to the first candidate movement restriction member by aligning the second engagement member with the

23

first candidate movement restriction member and engaging, joining, attaching, or otherwise coupling the second engagement member and the first candidate movement restriction member.

At **1650**, a wound status is identified. The wound status may relate to various qualities and properties of the wound, including but not limited to the health of the wound, the presence of any infections in the wound, the size of the wound (e.g., the distance between the first portion of skin on one side of the wound and the second portion of skin on the other side of the wound, etc.), any relative changes in the wound, the structural integrity of the wound (including inflation), the elasticity of the wound, tissue, or skin, etc. A user may identify the wound status, such as by observing the wound, using a sensor or other medical device to non-invasively identify properties of the wound, performing a test on the wound or material within the wound, measuring visible properties of the wound, etc.

At **1660**, a determination is made as to whether the wound status is satisfactory. For example, the wound status may be satisfactory if the wound is healing properly. The wound status may be unsatisfactory if the wound is infected, if the portions of skin on either side of the wound need to be drawn more closely together, if the force applied across the wound is not even, etc. A user may determine whether the wound status is satisfactory by comparing the wound status to a heuristic, a flow chart, or any other plan or strategy relevant to wound closure and wound healing.

If the wound status is not satisfactory (e.g., unsatisfactory), then at **1670**, the straps are adjusted to alter the positions of the strap ties and thus the portions of skin disposed on either side of the wound. In some embodiments, the wound status is not satisfactory because the force applied across the wound is not even. As such, at least one of the straps may be adjusted (e.g., drawn further through an opening of the other strap tie) in order to ensure that the force applied across the wound is even. A strap may be adjusted by grasping a portion of the strap (e.g., a distal end, etc.), and drawing the strap further (e.g., in a direction other than a direction in which the strap would be decoupled from the other strap tie) through the opening of the other strap tie. A user may adjust the positions of one or more strap ties by holding or otherwise grasping the strap of the strap tie, and drawing the strap further through the corresponding opening until a desired position is reached, such as a position at which the force applied across the wound is even.

If the wound status is satisfactory, then at **1680**, the strap tie assembly may be removed (e.g., unsecured, desecured, etc.). For example, attachment members may be removed from the portions of skin on either side of the wound. A user may remove the attachment members manually, by using a tool for removing the attachment members, etc.

In some embodiments, adjusting the straps includes engaging the engagement members with a new candidate movement restriction member. For example, a wound status may be unsatisfactory because the force applied across the wound is not even. A new candidate first movement restriction member may be selected along the first strap, and the first strap may be adjusted by drawing the first strap further through an opening of the second strap tie, then engaging the new candidate first movement restriction member with the appropriate second engagement member. A user may identify a new candidate movement restriction member, adjust the position of the straps, and engage the engagement member to the corresponding movement restriction member.

In some embodiments, a strap tie assembly is secured across a wound in a particular order. For example, a first strap

24

tie may be secured to a first portion of skin; next, a second strap may be received through a first opening in the first strap tie; next, the second strap tie from which the second strap extends may receive a first strap extending from the first strap tie; next, the second strap tie may be secured to a second portion of skin across a wound from the first portion of skin. In various embodiments, the order of these steps may be modified based on the availability of strap ties, the availability of attachment members, the status of the wound, the amount of time available to secure the wound, etc.

In some embodiments, the straps may be applied and reapplied from portions of skin adjacent to a wound. For example, a strap tie assembly may be used to secure a wound, then desecured (e.g., detached, removed, etc.) from the wound, then resecured (e.g., reattached, etc.) to the wound at a similar or different distance from or position relative to the wound, with a similar or different amount of force applied across the wound, etc. In some embodiments, a user may detach a strap tie assembly that was already secured to portions of skin adjacent to a wound from the portions of skin, and may reattach the strap tie assembly to the portions of skin.

While the present disclosure illustrates applications of a strap tie assembly for securing a wound, in various embodiments, a strap tie assembly may be used for various purposes, such as securing surfaces. For example, a strap tie assembly includes a first strap tie including a first base, a first body, and a first strap extending from the first body. The first base is configured to be disposed adjacent to a first surface. The first body includes a first opening and a first engagement member disposed within the first opening. The first strap includes a first proximal end attached to the first body, a first distal end opposite the first proximal end, and a plurality of first movement restriction members disposed along a surface of the first strap. The strap tie assembly also includes a second strap tie including a second base, a second body, and a second strap extending from the second body. The second base is configured to be disposed adjacent to a second surface. The second body includes a second opening and a second engagement member disposed within the second opening. The second strap includes a second proximal end attached to the second body, a second distal end opposite the second proximal end, and a plurality of second movement restriction members disposed along a surface of the second strap. The first opening is configured to receive the second strap, and the first engagement member is configured to engage one of the plurality of second movement restriction members of the second strap to prevent translation of the second strap away from the first body. The second opening is configured to receive the first strap, and the second engagement member is configured to engage one of the plurality of first movement restriction members of the first strap to prevent translation of the first strap away from the second body.

What is claimed is:

1. A strap tie assembly comprising:

a first strap tie including:

a first base configured to be disposed adjacent to a first portion of skin;

a first body including a first opening and a first engagement member disposed within the first opening, a second opening and a second engagement member disposed within the second opening, and a third portion positioned between the first opening and the second opening; and

a first strap integral to and extending from the first body, the first strap including a first proximal end extending from the third portion, a first distal end opposite the first proximal end, a first plurality of first movement

25

restriction members forming a portion of a first surface of the first strap, and a second plurality of first movement restriction members forming a portion of a second surface of the first strap opposite the first surface; and

a second strap tie including:

a second base configured to be disposed adjacent to a second portion of skin;

a second body including a third opening and a third engagement member disposed within the second opening, a fourth opening and a fourth engagement member disposed within the fourth opening, and a fourth portion disposed between the third opening and the fourth opening; and

a second strap integral to and extending from the second body, the second strap including a second proximal end extending from the fourth portion, a second distal end opposite the second proximal end, a first plurality of second movement restriction members forming a portion of a third surface of the second strap, and a second plurality of second movement restriction members forming a portion of a fourth surface of the second strap opposite the third surface;

wherein the first opening is configured to receive the second strap, and the first engagement member is configured to engage one of the first plurality of second movement restriction members of the second strap to prevent translation of the second strap away from the first body;

wherein the second opening is configured to receive the second strap, and the second engagement member is configured to engage one of the second plurality of second movement restriction members of the second strap to prevent translation of the second strap away from the first body;

wherein the third opening is configured to receive the first strap, and the third engagement member is configured to engage one of the first plurality of first movement restriction members of the first strap to prevent translation of the first strap away from the second body; and

wherein the fourth opening is configured to receive the first strap, and the fourth engagement member is configured to engage one of the second plurality of first movement restriction members of the first strap to prevent translation of the first strap away from the second body.

2. The strap tie assembly of claim 1, wherein at least one of the first engagement member, the second engagement member, the third engagement member, or the fourth engagement member includes a pawl.

3. The strap tie assembly of claim 1, wherein the first strap tie and the second strap tie are configured to apply an even amount of force on either side of a wound between the first portion of skin and the second portion of skin when the first strap and the second strap are engaged to a respective restriction member.

4. The strap tie assembly of claim 1, wherein at least one of the first plurality of the first movement restriction members, the first plurality of the second movement restriction members, the second plurality of the first movement restriction members, or the second plurality of the second movement restriction members includes a plurality of ridges.

5. The strap tie assembly of claim 1, wherein at least one of the first plurality of the first movement restriction members, the first plurality of the second movement restriction members, the second plurality of the first movement restriction

26

members, or the second plurality of the second movement restriction members includes a plurality of rims defining a plurality of strap openings, wherein each strap opening is configured to receive the respective engagement member.

6. The strap tie assembly of claim 1, wherein at least one of the first strap or the second strap includes a handle disposed at the distal end of the strap.

7. The strap tie assembly of claim 6, wherein the handle is detachably coupled to the strap.

8. The strap tie assembly of claim 1, wherein the first strap extends from the first body in a first direction, and the first base extends from the first body towards a second direction from the first body opposite the first direction.

9. The strap tie assembly of claim 1, wherein the first engagement member is configured to removably engage one or more of the first plurality of second movement restriction members of the second strap.

10. The strap tie assembly of claim 1, wherein the first strap and the second strap are disposed parallel to and in contact with each other when the first engagement member has engaged one of the first plurality of second movement restriction members and the third engagement member has engaged one of the first plurality of first movement restriction members.

11. A method of attaching a strap tie system comprising: detachably securing a first strap tie adjacent to a first portion of skin, the first strap tie including i) a first body including a first opening, a second opening, a first body portion positioned between the first opening and the second opening, a first engagement member disposed within the first opening, and a second engagement member disposed within the second opening, ii) a first strap integral to and extending from the first body and including a first plurality of first movement restriction members forming a portion of a first surface of the first strap, and a second plurality of first movement restriction members forming a portion of a second surface of the first strap opposite the first surface, and iii) a first base extending from the first body;

detachably securing a second strap tie adjacent to a second portion of skin, the second strap tie including i) a second body including a third opening, a fourth opening, a second body portion positioned between the third opening and the fourth opening, a third engagement member disposed within the third opening, and a fourth engagement member disposed within the fourth opening, ii) a second strap integral to and extending from the second body and including a first plurality of second movement restriction members forming a portion of a third surface of the second strap, and a second plurality of second movement restriction members forming a portion of a fourth surface of the second strap opposite the third surface, and iii) a second base extending from the second body;

engaging the first engagement member with a candidate second movement restriction member of the first plurality of second movement restriction members to prevent translation of the second strap away from the first body; and

engaging the third engagement member with a candidate first movement restriction member of the second plurality of first movement restriction members to prevent translation of the first strap away from the second body.

12. The method of claim 11, further comprising at least one of receiving the first strap in the third opening and receiving the second strap in the first opening.

27

13. The method of claim 11, further comprising detachably securing at least one of the first strap tie and the second strap tie at a selected distance from the wound, wherein the selected distance is configured to apply an even amount of force on either side of the wound.

14. The method of claim 11, further comprising adjusting at least one of the first strap or the second strap based on a status of the wound.

15. The method of claim 14, wherein adjusting the first strap includes engaging the first engagement member with a new candidate second movement restriction member and adjusting the second strap includes engaging the third engagement member with a new candidate first movement restriction member, the new candidate second movement restriction member and the new candidate first movement restriction member selected based upon a change in status of the wound.

16. The method of claim 11, wherein detachably securing the first strap tie adjacent to the first portion of skin includes securing the first base to the first portion of skin using an attachment member.

17. The method of claim 11, further comprising:

unsecuring the first strap tie from the first portion of skin; and
resecuring the first strap tie to a third portion of skin.

18. A strap tie for securing a wound, the strap tie comprising:

a body including a first opening, a second opening, and a first portion positioned between the first opening and the second opening;
a first engagement member disposed within the first opening, the first engagement member configured to engage

28

one of a plurality of movement restriction members of a remote strap tie to prevent translation of the remote strap tie away from the body;

a second engagement member disposed within the second opening, the second engagement member configured to engage one of the plurality of movement restriction members of the remote strap tie to prevent translation of the remote strap tie away from the body;

a strap integral to and extending from the body, the strap including a proximal end extending from the first portion, a distal end opposite the proximal end, a first plurality of movement restriction members forming a portion of a first surface of the strap, and a second plurality of movement restriction members forming a portion of a second surface of the strap opposite the first surface, the first plurality of movement restriction members and the second plurality of movement restriction members configured to be engaged by an engagement member of a remote strap tie; and

a base extending from the body, the base configured to be disposed adjacent to a second portion of skin.

19. The strap tie of claim 18, wherein at least one of the first plurality of movement restriction members or the second plurality of movement restriction members includes a plurality of ridges.

20. The strap tie of claim 18, wherein at least one of the first plurality of movement restriction members or the second plurality of movement restriction members includes a plurality of rims defining a plurality of strap openings, wherein each strap opening is configured to receive an engagement member of a remote strap tie.

* * * * *